RCRA Facility Investigation Report

On–Site Areas

Former CIBA Site

Cranston, Rhode Island

Volume 1:

Chapters 1–7

Submitted by:

CIBA Corporation

Route 37 West

Toms River, New Jersey 08754

31 July 1995

Rec'd
7-31-95
F.B.

ciba

Regional Remediation Team

Ciba-Geigy Corporation
P.O. Box 71
Toms River, NJ 08754
Telephone 908 914 2500
Fax 908 914 2917

July 28, 1995
87X4660

Mr. Frank Battaglia, Project Manager
USEPA Region I
Waste Management Building
90 Canal Street
Boston, MA 02114

NAME: Ciba Geigy
ID: RID001194323
FILE LOC: 4a.
OTHER: Vol. 1 of 3. Oversized

Re: Submittal of the On-Site RCRA Facility Investigation Report
Ciba Cranston, Rhode Island Facility

Dear Mr. Battaglia:

Ciba is pleased to submit 5 copies of the On-Site RCRA Facility Investigation Report for the Cranston, Rhode Island facility. This document is organized in three volumes:

Volume 1 - includes the Executive Summary and Chapters 1 through 7,

Volume 2 - includes the references and appendices for Chapters 1 through 5, and

Volume 3 - presents the PHERE as a stand alone document. It includes Chapter 6 and the associated appendices.

If during your review of this document you have comments or questions, or require additional copies, please feel free to contact me. We look forward toward you input.

Very truly yours,

FOR

Dr. Barry Berdahl, C.H.M.M.
Project Coordinator

cc. J. Unsworth (RIDEM)
Mayor Traficante (City of Cranston)
Mayor Chafee (City of Warwick)

VOLUME 2: REFERENCES AND APPENDICES

REFERENCES

APPENDICES

VOLUME 3: PUBLIC HEALTH AND ENVIRONMENTAL RISK EVALUATION

List of Tables

List of Tables, continued

List of Figures

List of Appendices

OVERVIEW

This document presents the results of the RCRA Facility Investigation (RFI) that was conducted at the former Ciba-Geigy Corporation facility at Cranston, Rhode Island (the Site). The RFI involved three main studies - a physical characterization, a release characterization, and a public health and environmental risk evaluation (PHERE). The physical characterization was designed to evaluate the environmental setting of the Site and involved three interrelated studies - geologic, hydrogeologic and hydrologic. The release characterization was designed to evaluate the impact of releases at the Site; it was organized geographically based on the three on-site study areas (the Production Area, the Waste Water Treatment Area and the Warwick Area), off-site areas, and the Pawtuxet River. The results of the Pawtuxet River RFI will be addressed in a separate report that will be submitted at a latter date. Figure ES-1 shows the locations of the Solid Waste Management Units (SWMUs), Areas of Concern (AOCs), and Additional Areas of Investigation (AAOIs).

The PHERE was designed to evaluate if site-related chemical will pose an unacceptable public health or ecological risk in the future. If the target risks for on-site chemicals were exceeded, then Media Protection Standards (MPS) for the chemicals were proposed.

BACKGROUND AND OBJECTIVES

Beginning in 1930, the Alrose Chemical Company manufactured chemicals at the Site. The GEIGY Chemical Company purchased the Site in 1954 and merged with the Ciba Corporation in 1970. The facility operated until May 1986. Throughout its operational history, the Site was used for the manufacture of various agricultural products, leather and textile auxiliaries, plastics additives, optical brighteners, pharmaceuticals, and bacteriostats.

An Administrative Order of Consent (Order) requiring a RCRA Corrective Action Study at the Site was issued to Ciba; it became effective on 16 June 1989. A RCRA Corrective Action Study has four stages: a RCRA Facility Assessment, a RCRA Facility Investigation, a Corrective Measures Study Proposal, and a Corrective Measures Study Report. A RCRA Facility Assessment (RFA) was performed by the USEPA; a Final RFA Report was issued in January 1988. The RFA determined that known and/or suspected releases had occurred at the Site. A RCRA Facility Investigation (RFI) was conducted to characterize the impact of releases that were determined by the RFA to require further action. This report contains the results of the RFI. The investigatory methods and results of the RFI studies, conclusions and recommendations are summarized below. As agreed with USEPA, a Corrective

Measures Study (CMS) Proposal is not required for this investigation. A focused CMS will be performed as described in a letter to the USEPA dated June 30, 1995. The CMS Report will evaluate the technologies that are proposed to meet the MPS. The On-Site CMS Report will be submitted in September 1995.

PHYSICAL CHARACTERIZATION

The Physical Characterization of the Site included studies of geology, hydrogeology, and hydrology. The geologic and hydrogeologic studies are discussed here. The hydrologic studies will be discussed in the Pawtuxet River RFI Report.

Geologic Site Model

Several investigatory methods were used to investigate the geologic characteristics of the Site including a literature review; reconnaissance mapping; geophysical surveys; subsurface investigations; and geotechnical samples analyses. Results from each of these studies were used to build the geologic model of the Site (described below).

Bedrock beneath the Site consists of a medium-grained, quartz-biotite sandstone and a thin bedded, slightly phyllitic shale of the Rhode Island Formation. The depth to bedrock beneath the Site varies from approximately 30 to 90 feet below ground surface.

Bedrock is overlain by unconsolidated deposits. From ground surface to the top of bedrock these include an Upper Sand/Fill unit; a Silt unit; a Gravelly Sand unit; a Fine Sand unit; and a Glacial Till unit. The thicknesses and extents of these units vary across the Site. In the Production Area, approximately 50 to 60 feet of overburden deposits overlie bedrock. The upper unit in the Production Area is mostly fill - typically concrete rubble in a sandy matrix. The Silt unit underlies most of the Production Area, but is replaced in one area by the Gravelly Sand unit. The Gravelly Sand unit occurs only in the Production Area and is up to 25 feet thick. The Fine Sand and Glacial Till units appear to be continuous beneath the Production Area.

Most of the Waste Water Treatment Area is also underlain by the typical stratigraphic sequence. However, the Glacial Till unit is not present at the eastern end of the area.

Most of the Warwick Area is underlain by the typical stratigraphic sequence consisting of an Upper Sand/Fill unit, Silt unit, Fine Sand unit, and Glacial Till over bedrock. The Glacial Till is found only in the western portion of the Warwick Area, and along the river.

Hydrogeologic Model

Investigatory methods used to investigate the hydrogeologic characteristics of the Site included a literature review, installing wells and piezometers, monitoring water levels, determining hydrochemisty, performing grain size analyses, and conducting aquifer permeability testing. Results from each of these studies were used to build the hydrogeologic model of the Site described below.

Groundwater that is present in the various overburden units beneath the Site is interconnected. The Silt unit acts to semi-confine the underlying Fine Sand unit. The amount of confining pressure present depends on the thickness and composition of the Silt unit. Hydraulic gradients between the shallow and deep overburden are predominantly upward, with the exception of wells near the bulkhead in the Production Area. The overburden units are hydraulically connected to the Pawtuxet River. In each area of the Site, groundwater in the shallow and deep overburden flows toward the River. Bedrock is semi-confined or confined and is not believed to be hydraulically connected to either the overburden units or the Pawtuxet River.

Groundwater discharges into the Pawtuxet River at estimated rates of 15,000 ft^3/day each in the Production and Waste Water Treatment Areas, and 45,000 ft^3/day in the Warwick Area. Groundwater flow velocities range from 6 to 28 feet/day in the Upper Sand/Fill and Gravelly Sand units and 0.6 to 38 feet/day in the Fine Sand unit.

SOURCE CHARACTERIZATION

The Order requires that Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) and the waste placed in them be characterized. Because buildings were razed and wastes were removed when the plant was decommissioned, wastes were not available to be characterized (except SWMU-6, the zinc/oxide pile). Therefore, the source characterization is based on historical information. Potential sources identified at the Site are shown on Figure 1-1, and described below.

PRODUCTION AREA

SWMU-2 - a 6,000 gallon above ground tank used to store hazardous liquid waste containing acetone, toluene, monochlorobenzene, ethanol, isopropanol, naphthalite, xylene, heptane, and methanol. This tank had secondary containment. Wastes were pumped from the tank into railroad tank cars. No releases from this tank were known or suspected.

SWMU-3 - a 7,500 gallon above ground tank used to store flammable waste liquids. This tank had secondary containment. Wastes were pumped from the tank into railroad tank cars. No releases from this tank were known or

suspected.

SWMU-4 - a trash compactor station where packaging material, waste paper, and washed fiber drums were handled. Compacted materials were taken to a sanitary landfill or incinerated. There were no known or suspected releases from this SWMU. Investigation of this SWMU is not required by the Order.

SWMU-7 - an area where approximately 500 gallons of chlorosulfonic acid were spilled from a tanker truck. Soils in the release area were neutralized and excavated. The neutralizing agent used and the amount of soil removed is not known.

SWMU-8 - it is believed (but not documented) that potassium ferrocyanide (Prussian Blue) was spilled in this area. At least 300 cubic yards of blue stained soil were removed from this area.

SWMU-11 - a subsurface sump beneath Building 11 from which waste water containing toluene was released.

AOC-13 - the portion (south end) of the Production Area where most of the manufacturing took place. Because little is known about early operations at the Site, this main manufacturing area was considered an Area of Concern.

AOC-14 - 23 acres of land west of the Production Area purchased, but not used by Ciba. Because there are no known or suspected releases from this area, investigation of AOC-14 was not required by the Order.

AAOI-15 - a waste water sump in the laboratory building at the north end of the Production Area. There are no known spills or suspected releases from this sump.

WASTE WATER TREATMENT AREA

SWMU-10 - 50,000 gallons of waste water escaped from a break in an underground pipeline in the wastewater treatment plant. The water reached the surface, flowed around an equalization tank, into a pond, and into the Pawtuxet River.

SWMU-12 - a biological waste water treatment plant which operated from 1975 to 1986 when the plant closed. While in operation, occasional sump overflow from trickling towers occurred. These waste waters would have contained volatile and semi-volatile organic compounds. Other discharges resulted in NPDES permit exceedances for zinc, BOD, and phenols. In some instances, compounds not authorized under the permit, such as chloroform,

were released.

WARWICK AREA

SWMU-1 - a hazardous waste storage area used to store drums of hazardous waste. There are no known releases from this area, and it was deemed to be in good physical condition at the time it was closed. Therefore, investigation of this unit was not required by the Order.

SWMU-5 - dredged river sediment storage area. This area was used to dewater 6,630 cubic yards of sediment removed from the cofferdam/waste water outfall in the river, adjacent to the Production Area. Little is known about the shape and exact location of this area.

SWMU-6 - a soil pile containing residues of zinc oxide from a broken rail car spill. This material is not a RCRA-regulated waste, and therefore, was not characterized as part of this source characterization.

SWMU-9 - 24,000 gallons of waste water was released from a pipeline break. This water is believed to have contained halogenated and non-halogenated solvents and other organic compounds.

SWMU-16 - a maintenance department cleaning area where rinse water was probably allowed to drain to a nearby surface water catch basin. This area was originally designated as an Area of Additional Investigation (AAOI) by Ciba. Phase I sampling results indicated that some contaminants were present in shallow groundwater in this area. As a result, this AAOI was reclassified as a SWMU.

RELEASE CHARACTERIZATION

Environmental media were sampled from SWMUs, AOCs and AAOIs, and from off-site areas. Samples were analyzed for Appendix IX compounds to determine if the media had been affected by previous Site operations. The results of these analyses are summarized below.

Groundwater Contamination

Background Groundwater - Low levels of volatile organic compounds (generally less than 50 ppb) were detected in shallow groundwater at off-site and on-site background locations. Pesticides, dioxins and furans were detected sporadically in shallow groundwater at background locations. Groundwater in bedrock at the off-site background location sampled was essentially free of contaminants.

Production Area Groundwater - Groundwater contamination is largely limited to shallow groundwater in the former process building area (AOC-13). The primary contributors to contamination are toluene, xylenes, ethylbenzene, and chlorobenzene. Groundwater in deeper portions of the overburden contains little contamination. Elevated levels of total nickel were detected in shallow and deep overburden wells along the bulkhead. Groundwater in bedrock is essentially free of contaminants. Free phase toluene was identified in the Production Area. Dowtherm - a non-floating phase - was also identified.

Waste Water Treatment Area Groundwater - Low levels of groundwater contaminants were detected in shallow and deep overburden wells. The primary contributors to contamination are halogenated VOCs. Phenols were also detected in shallow wells. Samples from the bedrock well were essentially uncontaminated.

Warwick Area Groundwater - VOCs and SVOCs appear to be limited to the shallow groundwater beneath SWMU-5, and their concentrations are generally low. SVOCs are also present in the bedrock aquifer beneath SWMU-5. The specific SVOCs detected in the shallow groundwater are not the same as those detected in the bedrock aquifer suggesting that there is no relation between sources of contaminants in the overburden aquifer and the bedrock aquifer.

Low levels (less than 35 ppb) of 1,1,1-trichloroethane were detected in shallow groundwater in the area of SWMU-16. 1,1,1-Trichloroethane concentrations decreased by an order of magnitude between January and September 1991, and were not detectable in 1993.

Elevated levels of total and dissolved beryllium, cadmium, chromium and zinc were detected in SWMU-5. Elevated levels of total and dissolved zinc and total chromium were detected in SWMU-16.

Soil Contamination

Background/Off-site Soil Contamination - Contaminants detected in background/off-site soil samples are typical of urban locations. All of the samples contained PAHs which are components of petroleum products such as fuels and lubricants, products of combustion, and also occur naturally. Many of the samples contained toluene which is also a component of fuels. Low levels of pesticides, herbicides, chlorinated dioxins, and metals were also detected in background/off-site soil samples.

Production Area Soil Contamination - Shallow soil contamination in the Production Area is largely limited to PCBs, xylenes, and toluene in the process building area. The highest concentrations of PCBs were found near the southern end of the process building area. The highest concentrations of VOCs in shallow soil samples were in the area of SWMU-8. Deep soil in the process building area contained

ethylbenzene, xylenes and toluene. The highest concentrations of VOCs in deep soil samples were detected in the area of SWMU-11.

Toluene, chlorobenzene, ethylbenzene and xylenes were detected in soil gas samples from the process building area. The highest concentrations were detected in the area of SWMU-11. There are good correlations between high concentrations of toluene in soil samples from the area of SWMU-11 with high concentrations of toluene in soil gas results as well as between detections of high concentrations of total xylenes in soil samples from SWMUs -3, -7, -8, and -11 with high concentrations of xylenes in soil gas results. However, chlorobenzene in soil samples versus chlorobenzene in soil gas did not correlate well.

Elevated levels of nickel were detected in shallow soils, especially along Mill Street in AOC-13. Elevated concentrations of nickel were detected in deep soils, especially in SWMU-2 and SWMU-8.

Waste Water Treatment Area Soil Contamination - VOCs, SVOCs, and tetrachlorodibenzofuran were detected in nearly all of the soil samples. Toluene, m- & p-xylene, and chlorobenzene were detected in concentrations of 13 ppm or less. SVOCs were detected in concentrations below 10 ppm. Fingerprint compounds (see Section 4.2.1.2) were detected in concentrations up to 340 ppm. Tetrachlorodibenzofuran was detected in concentrations up to 8.9 ppb.

Warwick Area Soil Contamination - Contaminated soil in the Warwick Area is largely confined to soils in SWMU-5. Methoxychlor and PCBs were prevalent at relatively high concentrations in SWMU-5 shallow soil samples. One deep soil sample from SWMU-5 contained elevated levels of chlorobenzene and toluene. Bis(2-ethylhexyl)phthalate was detected in elevated concentrations in both shallow and deep soil samples. Soil gas in the area of SWMU-16 contained 1,1,1-trichloroethane. Elevated levels of beryllium, cadmium, chromium, zinc and antimony were detected in Warwick Area soils. The highest concentrations of these analytes were detected in SMWU-5.

On-site Surface Water and Sediment Contamination

Surface water in the Wastewater Treatment Area wetland area is essentially uncontaminated. The Wastewater Treatment Area sediment contains low levels of the types of analytes seen in Site surface soils. VOCs were detected in concentrations below 0.2 ppm. PAHs were detected in concentrations below 6 ppm. Pesticides were detected in concentration below 0.6 ppm. 2,3,7,8 tetrachlorodibenzofuran was detected in concentrations below 0.05 ppb. In general, the sediment does not appear to be substantially impacted by Site activities.

Contaminant Fate and Transport

The assessment of the fate and transport of the chemicals of concern at the site indicate that VOCs have the highest mobility of the chemical groups identified. Therefore, these chemicals have the highest potential to migrate to the groundwater and discharge to the Pawtuxet River. Chemicals present in the groundwater in the Waste Water Treatment Area and the Warwick Area were present in groundwater in the shallow overburden and not in the deep overburden. VOCs were present groundwater in both the shallow and deep overburden in the Production Area. VOCs present in the deep overburden in the Production Area are the result of downward vertical groundwater gradients as well as the presence of the Sand/Gravel unit which connects the shallow and deep overburden.

Most SVOCs, PCBs, pesticides, herbicides, and dioxins/furans are present predominantly in the soils due to their strongly hydrophobic nature. Therefore, these chemicals are not expected to leach appreciably from the soils. Naphthalene, aniline, and benzyl alcohol, have high mobilities relative to the other SVOCs and may migrate with groundwater and ultimately discharge to the Pawtuxet River.

PUBLIC HEALTH AND ECOLOGICAL RISK EVALUATION

A Public Health and Environmental Risk Evaluation (PHERE) was prepared as part of the RFI, as required in the Order. It separately evaluates the potential human health and ecological risks associated with the Production, Waste Water Treatment, and Warwick Areas. It is consistent with the approach outlined in the USEPA's primary risk assessment guidance documents. The PHERE approach and values for exposure assumptions reflect discussions held with the Region I during several meetings and teleconferences, beginning with the May 17, 1994, meeting with Ciba at the Region I offices. The PHERE is presented in two parts; the public health risk assessment (PHRA) and the ecological risk assessment. The PHERE is a quantitative baseline study which assumes the property will be used without modification regardless of the practicality of this assumption. The risk reduction effectiveness of IRMs conducted in the Production and Warwick Areas is addressed qualitatively.

The purpose of the PHERE is threefold:

- Provide estimates of potential risks posed by site-related chemicals in the Production, Waste Water Treatment, and Warwick Areas of the Site using the conservative guidance specified by Region I.
- Identify the site areas and chemicals that might require corrective action using this risk assessment approach.
- Provide site-specific risk assessment models for human and ecological health to be used in developing risk-based Media Protection Standards (MPS) for soil, if needed.

Public Health Risk Assessment

The PHRA is designed to provide a conservative, quantitative estimate of potential risks associated with residual site-related chemicals in the Production, Waste Water Treatment, and Warwick Areas. It is based on analytical results from soil and groundwater samples collected during Phase I and II of the RFI field activities. It was performed by identifying chemicals of potential concern (COPCs) and carrying them through the risk assessment process. The COPCs were determined based on their toxicities, frequencies of detection, concentrations in site soil, and, for inorganics and polycyclic aromatic hydrocarbons (PAHs), comparison to background concentrations.

Regarding potential future land use, unrestricted residential use was assumed for the Warwick Area and Waste Water Treatment Areas. Based on a proposal to use the Production Area as a truck parking and equipment storage facility, the PHRA reflects an on-site worker scenario for this area. The PHRA also considered the potential human health effects associated with the migration of site-related chemicals, via groundwater, to the Pawtuxet River. Therefore, potential exposure to a canoeist is estimated for each of the three site areas.

Results of the PHRA are expressed in terms of potential noncancer health effects and potential cancer risks which are summarized in Figures ES-2, ES-3, ES-4, and ES-5. The total hazard index (THI) represents the overall estimated noncancer risks for a given exposure scenario. The potential noncancer risk represented by the THI is considered of no significance if it is equal to or below a value of 1, and is a potential concern if it is greater than a value of 1 (rounded to a whole number). The potential cancer risk posed is expressed in terms of an incremental lifetime cancer risk (ILCR). The ILCR is an increased probability of cancer above that which exists as "background" (3 out of 10 people) for the general population. The USEPA regards an ILCR of between 1 x 10^{-6} (1 in 1,000,000) and 1 x 10^{-4} (1 in 10,000) as acceptable. Thus, this may be interpreted as an increase in the United States baseline cancer incidence from 300,000 per million population to a range of 300,001 to 300,100 per million population. If the ILCR exceeds the upper bound of the target risk range (1 x 10^{-4}), then further evaluation or corrective action may be indicated.

As shown in Figures ES-2 and ES-3, neither the Production nor the Waste Water Treatment Area is predicted to pose an unacceptable potential risk. The potential total ILCR and total PCB ILCR slightly exceed the target risk range for the hypothetical resident in the Warwick Area (Figure ES-4), but only because the PCBs are totaled and treated as if they were the carcinogenic PCB 1260. No PCB 1260 was found in the Warwick Area or the Waste Water Treatment Area. The risk numbers presented are highly conservative and may exaggerate actual risks due to a number of factors. For example, the sampling approach was biased in that the field investigation targeted highly localized areas of suspected contamination. Additionally, at Region I's request, the total PCB carcinogenic risk is based on the assumption that all PCBs, including those that are noncarcinogenic (e.g. PCB 1248 and 1254) have a cancer potency factor equal to PCB 1260. The potential human health risks associated with the canoeist scenario on the adjacent river are estimated to be nonexistent, with ILCR values less

than 3×10^{-8} and THI values less than 0.003 in each of the three Site areas (Figure ES-5).

Even with the high degree of conservatism, the PHRA showed that corrective actions are not necessary for the three site areas solely on the basis of potential risk to public health, with the possible exception of the Warwick Area. However, Ciba volunteered to conduct some limited remediation in the Production Area and the Warwick Area to facilitate their productive use. Based on the concentration and frequency of detection in surface soil (the predominant exposure source), it was determined that PCB hot-spot removal in the Production and Warwick Areas would be an effective corrective measure to facilitate their productive use. Interim Remedial Measures (IRMs) were planned and are in progress as of submission of this document to Region I.

Ecological Risk Assessment

This ecological risk assessment utilizes the risk assessment process as defined by the *Framework for Ecological Risk Assessment* (USEPA, 1992). The objective of this ecological risk assessment is to evaluate potential risks posed to terrestrial receptors by COPCs contained in surface soils (0-2 feet) at the Production and Warwick Areas, and surface soils and seep sediments at the Waste Water Treatment Area.

A terrestrial/riparian reconnaissance survey was conducted at the Site in March, 1992. The terrestrial survey identified twenty-eight species of upland plants and twenty-six species of riparian/wetland plants at and near the Site. Twenty-six species of birds were identified, including: the great blue heron, mallard duck, and red-tailed hawk. Five mammal species were identified, including the Eastern gray squirrel and the raccoon. A seep area was electroshocked, but no fish were observed. Tadpoles were present in the seep.

Potential exposure pathways for plants and animals include:

- uptake through roots in contact with surface soils,
- foliar uptake of volatilized contaminants,
- consumption (incidental ingestion) of surface soils,
- dermal uptake, and
- ingestion of contaminants which have bioaccumulated into forage or prey items.

The ecological risk assessment is presented in three steps:

Step I--Problem Formulation
Problem formulation is a process which determines the feasibility, scope, and objective of the assessment. This step identifies the COPCs, the organisms which are representative of the site, the models to be used to determine potential dose from COPCs, and appropriate assessment and measurement endpoints.

Chemical analysis of the surface soils and the toxicity-background concentration screening process resulted in identification of the following:

	Inorganic COPCs	*Organic COPCs*
Production Area	11	41
Warwick Area	14	62
Waste Water Treatment Area	11	53
Seep in the Waste Water Treatment Area	11	32

Representative species were chosen to represent the major trophic levels: a small omnivorous mammal (deer mouse, *Peromyscus* sp.), a large terrestrial omnivore (raccoon, *Procyon lotor*), an aquatic carnivorous bird (great blue heron, *Ardea herodias)* and a carnivorous bird and protected species (red-tailed hawk, *Buteo jamaicensis*). The site, although highly disturbed, has habitat that could be used by each of these organisms. The great blue heron would only possibly use the groundwater seep in the Waste Water Treatment Area. Measurement endpoints for the organisms were chosen as the no-observable-adverse-effect level (NOAEL) for each COPC.

Step II-Exposure Characterization
Models of exposure pathways were developed to estimate daily dose to the representative organisms. These models include direct exposure, as well as bioaccumulation through the food chain.

Step III--Risk Characterization
The risk characterization step quantifies the likelihood of COPCs to cause adverse effects. The toxicity reference values (TRVs), which are equivalent to the NOAELs, are compared to predicted daily doses consumed by each representative species. A toxicity quotient (TQ) is developed that indicates the potential for adverse effects. Assumptions, strengths, weaknesses, and uncertainties of the analyses are discussed as well as potential ecological significance of any effects.

A COPC is judged to have potential for adverse effects if the TQ is greater than zero. All calculated TQs for representative species were less than zero.

Potential cumulative effects were also estimated by calculating an ecological toxicity index (ETI). Index values below one indicate no potential for adverse effect, values between one and ten have some possibility for effect, and probable adverse impact occurs when the ETI exceeds 10.0. The ETI was greater than 1.0 (1.36) only for the deer mouse in the Waste Water Treatment Area. The ETI was below one for all other species in the three Areas.

Potential risk from COPCs in the three areas at the site is small. The TQ for any single chemical is below zero, indicating no potential for adverse effects. Therefore, the ETI indicates no significant risks are expected to the representative species.

Future risk due to changes in site characteristics will be even less than current risk. For example, soils in SWMU-5 and SWMU-6 in the Warwick Area will be removed during the IRM activities. These soils contained the majority of the contamination in this Area. Removal of PCB-contaminated soil and backfilling the entire area eliminates any pathway for risk to terrestrial receptors. Therefore, the Site poses even less an ecological risk than portrayed in this baseline assessment.

Media Protection Standards

The public health and environmental risk assessment showed that corrective actions are unnecessary for the three terrestrial Site areas, with the possible exception of the Warwick Area. The PHERE corroborates that the voluntary PCB hot-spot removals begun during the IRMs in the Production and Warwick Areas are more than sufficient to return the Site to productive uses without unacceptable risks to public health and the environment.

The public health risk assessment models for the scenarios evaluated were used to estimate risk-based MPS values for total PCBs in the hot spots targeted for remediation in the IRMs. These MPSs were developed solely for the purposes of the IRMs, and not because of any overriding potential public health or ecological health risks. Using a THI value of 1, MPSs were back-calculated through the risk assessment model to the respective surface soil concentrations. The resulting total PCB MPSs are 50 ppm for the Production Area and 5 ppm for the Warwick Area.

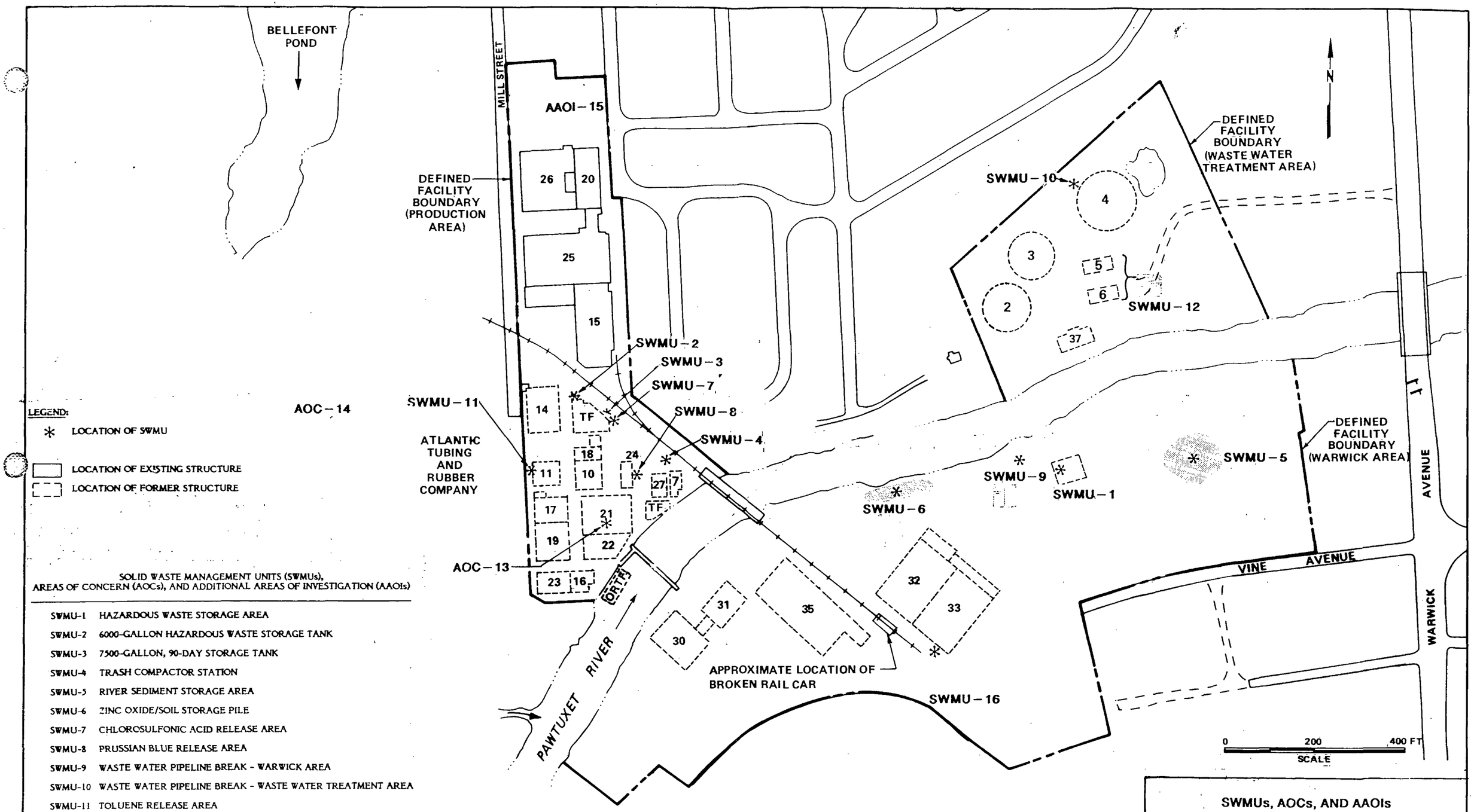
CONCLUSIONS

Based on the findings of this RFI, the following is concluded:

- On-site contaminated groundwater beneath the Site does not pose an unacceptable risk to human health or the environment. Potential risks posed by groundwater to human and ecological receptors in the Pawtuxet River will be addressed in a separate report.

- Contaminants in Site soils do not pose an unacceptable risk to human health or the environment.

- Contaminants in on-site surface water and sediment do not pose an unacceptable risk to human health or the environment.



LEGEND:

* LOCATION OF SWMU

LOCATION OF EXISTING STRUCTURE

LOCATION OF FORMER STRUCTURE

SOLID WASTE MANAGEMENT UNITS (SWMUs), AREAS OF CONCERN (AOCs), AND ADDITIONAL AREAS OF INVESTIGATION (AAOIs)

SWMU-1	HAZARDOUS WASTE STORAGE AREA
SWMU-2	6000-GALLON HAZARDOUS WASTE STORAGE TANK
SWMU-3	7500-GALLON, 90-DAY STORAGE TANK
SWMU-4	TRASH COMPACTOR STATION
SWMU-5	RIVER SEDIMENT STORAGE AREA
SWMU-6	ZINC OXIDE/SOIL STORAGE PILE
SWMU-7	CHLOROSULFONIC ACID RELEASE AREA
SWMU-8	PRUSSIAN BLUE RELEASE AREA
SWMU-9	WASTE WATER PIPELINE BREAK - WARWICK AREA
SWMU-10	WASTE WATER PIPELINE BREAK - WASTE WATER TREATMENT AREA
SWMU-11	TOLUENE RELEASE AREA
SWMU-12	WASTE WATER TREATMENT PLANT
AOC-13	PROCESS BUILDING AREA
AOC-14	ATLANTIC TUBING AND RUBBER COMPANY PROPERTY
AAOI-15	LABORATORY BUILDING WASTE WATER SUMP
SWMU-16	MAINTENANCE DEPARTMENT CLEANING AREA

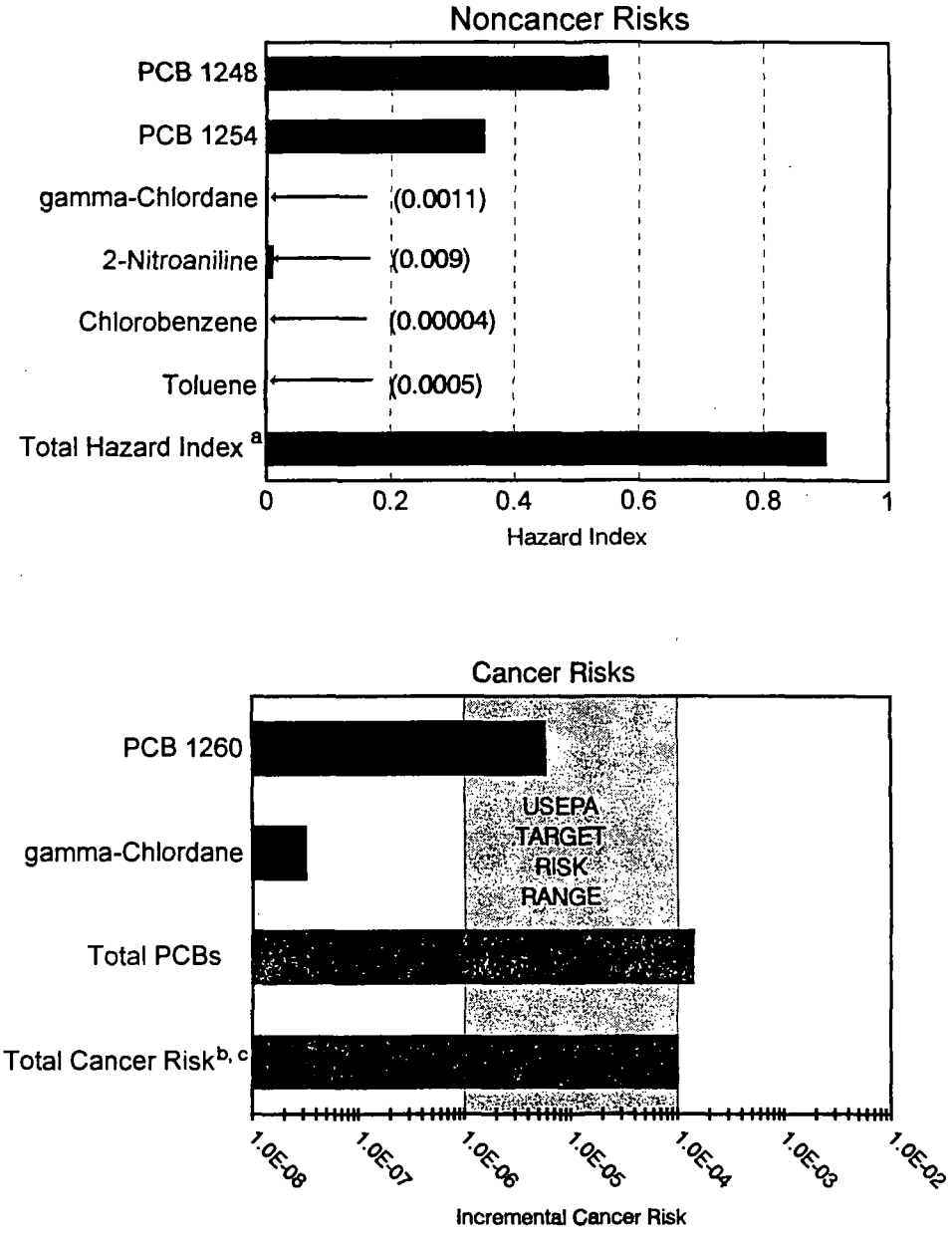
BASE MAP SOURCE: GEOD CORPORATION OF NEWFOUNDLAND, NEW JERSEY, MAPPED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHS. DATE FLOWN: 2 APRIL 1989

SWMUs, AOCs, AND AAOIs

WOODWARD – CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
WAYNE, NEW JERSEY

DR. BY:	KF	SCALE:	1:2400	PROJ. NO.:	87X4660
CK'D. BY:	MH	DATE:	20 JAN 1992	FIG. NO.:	ES–1

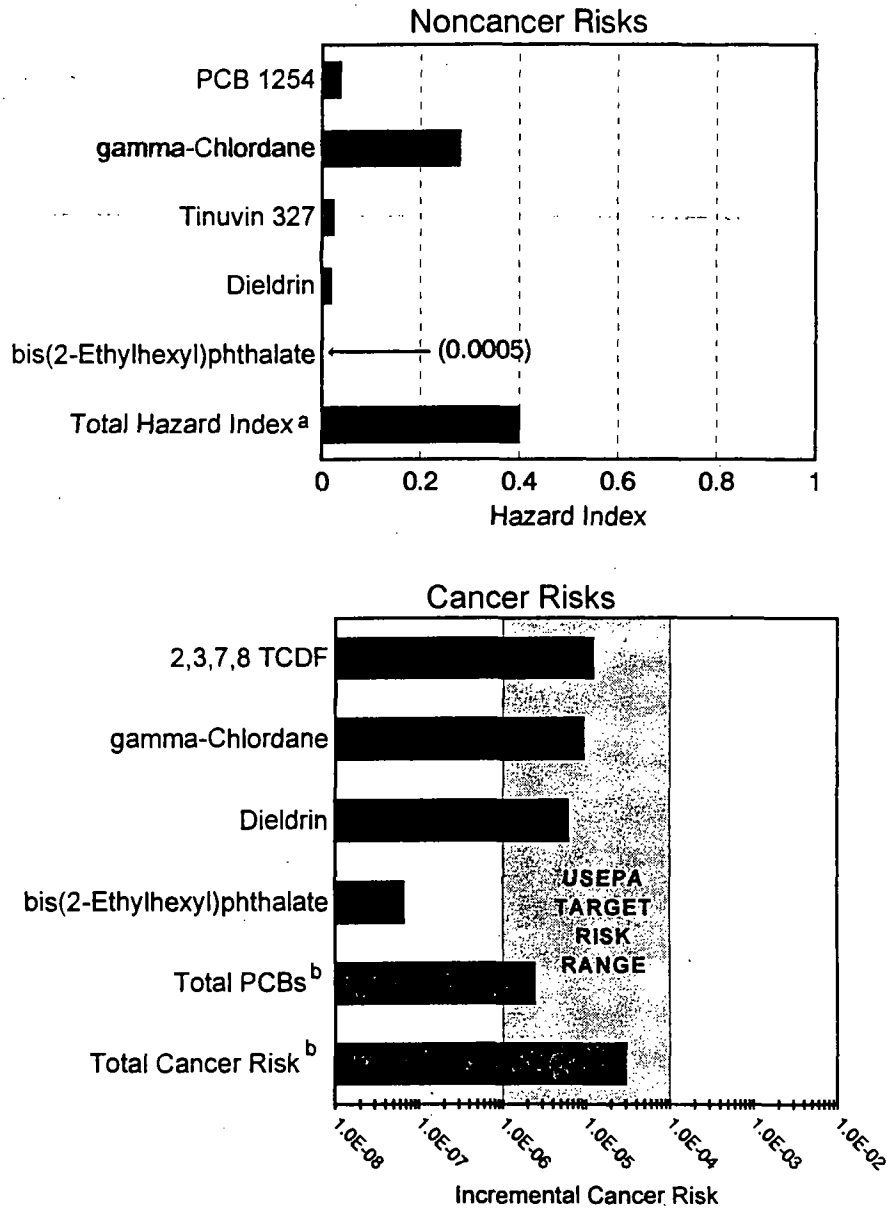


a. All hazards are summed regardless of target organ. Refer to Section 6.4.3.2 and Appendix 6-G.

b. According to USEPA policy, all PCBs were totaled, even though only PCB 1260 is carcinogenic.

c. Rounded to one significant figure, as described in the Human Health Evaluation Manual (USEPA, 1989), making total risk slightly lower than that for total PCBs.

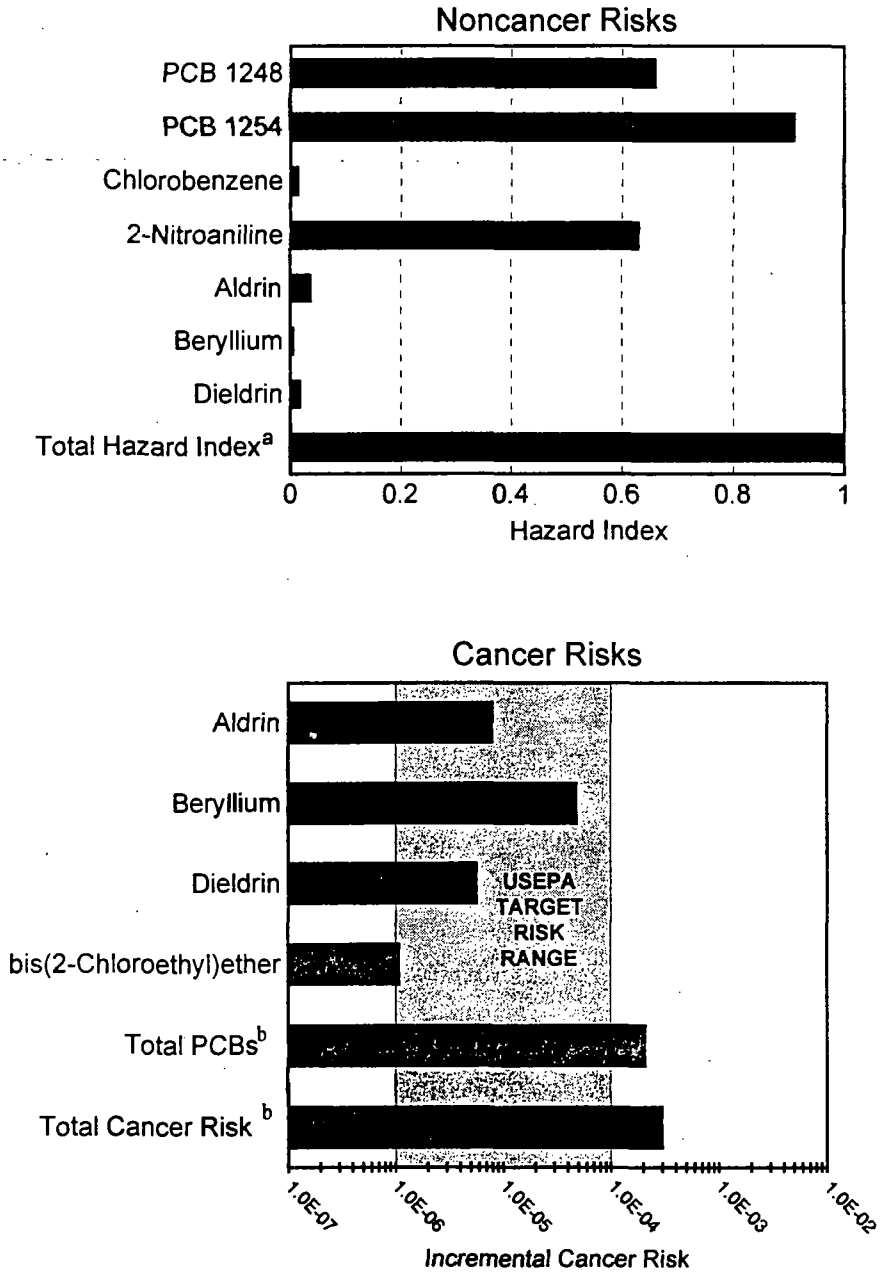
Figure ES-2. Risk Summary for Production Area On-Site Worker Scenario



a. All hazards are summed regardless of target organ. Refer to Section 6.4.3.2 and Appendix 6-G.

b. According to USEPA policy, all PCBs were totaled, even though only PCB 1260 is carcinogenic and no PCB 1260 was detected.

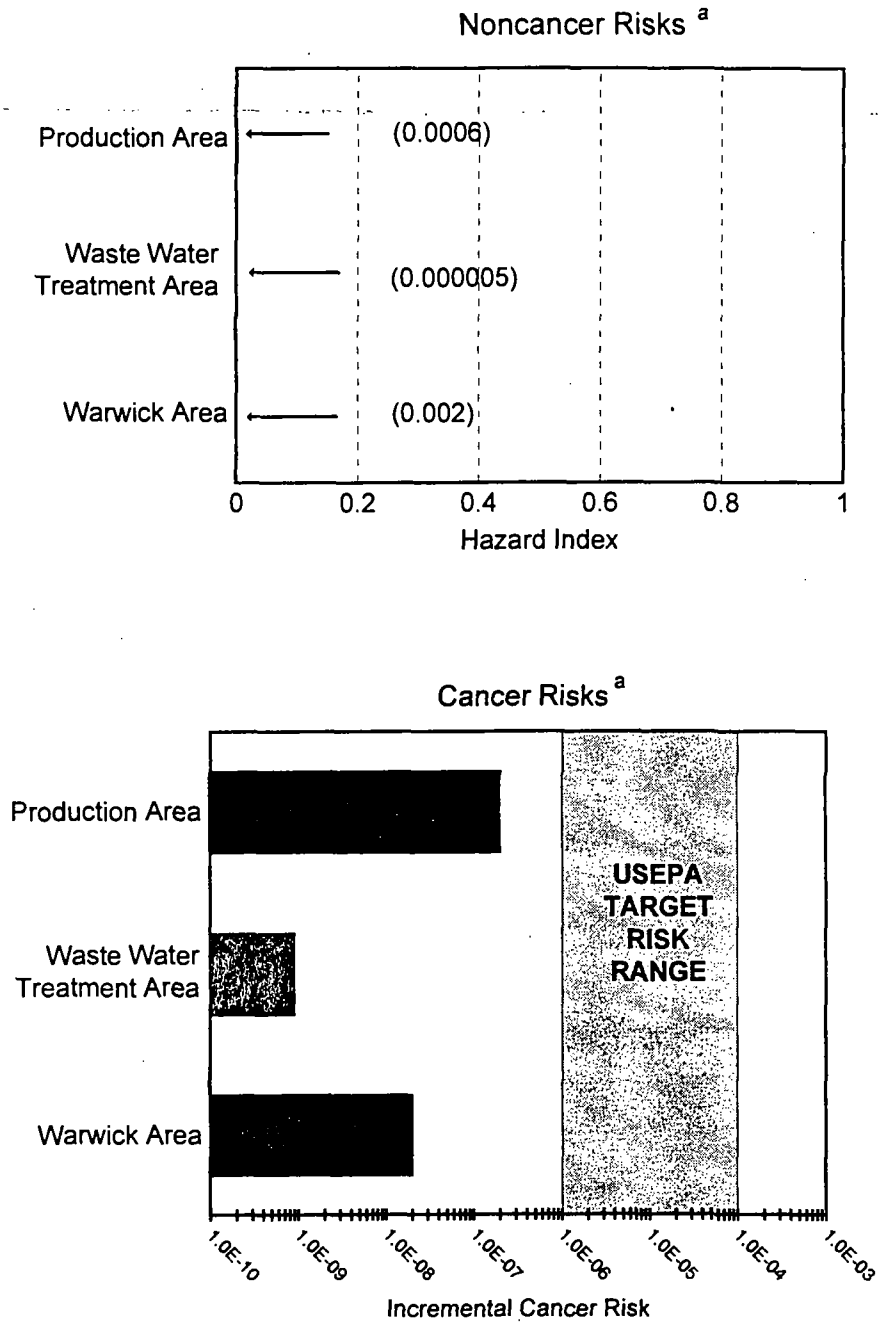
Figure ES-3. Risk Summary for Waste Water Treatment Area On-Site Resident Scenario



a. Only similar hazards are summed. Refer to Section 6.4.3.2 and Appendix 6-G.

b. According to USEPA policy, all PCBs were totaled, even though only PCB 1260 is carcinogenic and no PCB 1260 was detected.

Figure ES-4. Risk Summary for Warwick Area On-Site Resident Scenario



a. Same COPCs evaluated as for other scenarios associated with Site areas. Values assume additivity for the effects of all COPCs.

Figure ES-5. Risk Summary for Canoeist Scenario

1.0 INTRODUCTION

1.1 OVERVIEW

This RCRA Facility Investigation Report presents the results of the On-site RCRA Facility Investigation (RFI) at the CIBA-GEIGY Corporation facility (the Site) at Cranston, Rhode Island. This chapter reviews the history of the project and the Site (Section 1.2), presents the objectives of the RFI (Section 1.3), and provides the organization of the rest of this document (Section 1.4). Table 1-1 provides a summary of deliverables submitted to USEPA throughout this project.

1.2 BACKGROUND

This section describes:

- the project history;
- the Site history; and
- the solid waste management units (SWMUs), areas of concern (AOCs), and additional areas of investigation (AAOIs) at the Site.

Detailed information on each of these topics was presented in Chapter 1 of the Current Assessment Summary Report.

1.2.1 Project History

A draft Administrative Order of Consent (Order) requiring a RCRA Corrective Action Study at the facility was issued to CIBA-GEIGY on 30 September 1988. After negotiations and evaluation of public comments, the Order was signed by CIBA-GEIGY on 9 June 1989 and became effective on 16 June 1989. A RCRA Corrective Action Study has four stages. The chronology of project activities associated with each of these stages is outlined below.

Stage 1: **RCRA Facility Assessment**. In 1987, the U.S. Environmental Protection Agency (USEPA) conducted a RCRA Facility Assessment (RFA) to identify known and/or suspected releases at the Site. The results were presented in the Final RFA Report. CIBA-GEIGY RCRA Facility Assessment (January 1988). In 1988, CIBA-GEIGY conducted a Preliminary Investigation (not required by the Order) to begin characterizing the Site and selected releases. The results of the Preliminary Investigation were summarized in Chapter 1 of the Current Assessment Summary Report.

Stage 2: **RCRA Facility Investigation.** The RCRA Facility Investigation (hereafter simply called the RFI) was conducted to characterize the impact of known and/or suspected releases that were determined by the RFA to require further action. The RFI was conducted in two phases; CIBA-GEIGY proposed that Phase I be conducted in two parts -- Phases IA and IB -- to obtain additional guidance from the USEPA throughout the project. Phase IA was conducted in late 1989 and mid-1990 to characterize the Site's physical environment more completely; the results of the Phase IA studies were presented in the Phase IA Report (approved in June 1991). Phase IB was conducted in late 1990 and early 1991; it characterized known and/or suspected releases at the Site more completely and also provided additional information about the Site's physical environment. In Phase IB, two rounds of sampling were performed. Sampling and analysis of the media of concern included soil, groundwater, sediment, and surface water. The results of both Phase IA and Phase IB were presented in the Phase I Interim Report. Phase II began after the USEPA approved the Phase I Interim Report and Phase II Proposal. In Phase II, an additional two rounds of sampling was performed. Work completed during Phase II included: additional Site characterization studies, refinement of the conceptual Site model, conducting additional sampling, performing the public health and environmental risk evaluation, and developing the Media Protection Standards.

Stage 3: **Corrective Measures Study Proposal.** The Corrective Measures Study (CMS) Proposal describes the measures available to achieve the Media Protection Standards at the Site. A CMS Proposal will not be submitted for this project. As agreed with USEPA, a combined deliverable consisting of the RFI Report, the Media Protection Standards (MPS) Proposal, and the CMS Report would be submitted together in September 1995. Ciba has elected to submit the On-site RFI Report and the MPS Proposal ahead of schedule. The CMS Report will be submitted in September 1995.

Stage 4: **Corrective Measures Study Report.** The Corrective Measures Study (CMS) Report evaluates the measures available to achieve the Media Protection Standards at the Site. Work on the CMS Report is in progress. This deliverable will be submitted to USEPA in September 1995 as planned.

In addition to these four stages of the RCRA Corrective Action Study, stabilization and Interim Remedial Measures also have been implemented at the Site.

Stabilization Investigation

The stabilization investigation was integrated into the RCRA Facility Investigation (RFI) through a Modification of the Order executed on 28 September 1992. The Stabilization Work Plan was submitted to the USEPA in September 1992; conditional approval of the Work Plan was granted on 21 December 1992. The Stabilization Investigation Report and Design Concepts Proposal was submitted to the USEPA in May 1993. The Draft Stabilization Design Documents were submitted to the USEPA in November 1993. The Final Stabilization Design Documents were submitted to the USEPA in June 1994 and

approved on September 27, 1994. These final design documents were revised and resubmitted on January 30, 1995 because of changes to the groundwater pretreatment system.

Interim Remedial Measures

Interim Remedial Measures (IRMs) are being implemented at the Site. An IRM Work Plan for excavating and disposing of PCB-contaminated soil was submitted to USEPA on March 13, 1995. This Work Plan included a risk assessment which proposed IRM cleanup levels for the Production Area and for the Warwick Area (SWMU-5 and SWMU-6). It was implemented in late June and July 1995, and the results will be included in the Site CMS.

An IRM Work Plan for dredging sediments in the former Cofferdam Area was prepared and submitted to RIDEM and USEPA on April 28, 1995 for review and comment. This Work Plan addressed permitting, objectives, approach, and project management issues. The IRM is scheduled for implementation from September through the fourth quarter of 1995.

1.2.2 Site History

Beginning in 1930, the Alrose Chemical Company manufactured chemicals at the Site. The GEIGY Chemical Company of New York purchased the Site in 1954 and merged with the Ciba Corporation in 1970; thereafter, the Site was used for batch manufacturing of organic chemicals. Over time, the following major product categories were manufactured:

- 1950s--agricultural products, as well as leather and textile auxiliaries;
- 1960s--plastics additives, optical brighteners, pharmaceuticals, and textile auxiliaries;
- 1970s--agricultural products, plastics additives, pharmaceuticals, textile auxiliaries, and bacteriostats; and
- 1980s--plastics additives and pharmaceuticals.

By May 1986, CIBA-GEIGY had ceased all chemical manufacturing operations at the Site and had begun decommissioning and razing the plant. The Site has been divided into three study areas: the Production Area, the Warwick Area, and the Waste Water Treatment Area. The boundaries of these three areas are shown in Figure 1-1.

1.2.3 SWMUs, AOCs, and AAOIs

Twelve solid waste management units (SWMUs) and two areas of concern (AOCs) were identified in the Order. For completeness of the study, CIBA-GEIGY identified two additional areas of investigation (AAOIs). Information about these SWMUs, AOCs, and AAOIs is summarized in Table 1-2; their locations and the Media of Concern sampled in each are shown in Figure 1-1. Additional details about these SWMUS, AOCs, and AAOIs (and on past known and/or suspected releases) are presented in Chapter 3.

1.3 OBJECTIVES OF THE RCRA FACILITY INVESTIGATION

The RFI has been divided into five main tasks: physical characterization, source characterization, release characterization, public health and environmental risk evaluation (PHERE), and developing media protection standards. The release characterization has been subdivided into two tasks: the contamination characterization and contamination assessment. The objectives of these tasks are described briefly below.

1.3.1 Physical Characterization

The objective of the physical characterization of the Site was to characterize the lithology, stratigraphy, hydrogeology and hydrology of the Site. Mobilization for the Phase IA physical characterization began in early 1990; field studies began in mid-1990 and were completed by Autumn 1990. Mobilization for the Phase IB physical characterization began in Autumn 1990; field studies began in late 1990 and were completed by mid-1991. Phase II physical characterization field studies began in Spring 1992 and were completed by mid-1994. The results of the Phase IA physical characterization were presented in the Phase IA Report. Updated findings based on Phase IB results were presented in Chapters 2 through 5 of the Phase I Interim Report. Additional data obtained from the Phase II investigation were used to further refine the conceptual Site model (presented in Chapter 2 of this report).

1.3.2 Source Characterization

The objective of the source characterization was to characterize SWMUs, AOCs, and AAOIs and the wastes contained at these locations. Except for the zinc oxide/soil pile (SWMU-6), wastes were no longer present at the Site at the time of the RFI. Therefore, wastes could not be characterized, and source characterization was limited to SWMU, AOC, and AAOI characterization. Results of the source characterization are summarized in Chapter 3 of this report.

1.3.3 Release Characterization

The release characterization consisted of two parts - the contamination characterization and the contamination assessment.

Contamination Characterization
The objective of the contamination characterization of the Site was to define the nature and extent of contamination resulting from releases at the Site. Mobilization for the Phase I contamination characterization began in late 1990; field studies began in late 1990 and were completed by mid-1991. The Phase II release characterization sampling program is summarized in Table 1-3. Mobilization for the Phase II release characterization began in early 1992; field studies began in Spring 1992 and were completed by mid-1994. The results of the Phase I contamination characterization were presented in Chapters 6 through 9 of the Phase I Interim Report. Updated findings which also include the Phase II results are presented in Chapter 4 of this report.

Contamination Assessment
The objective of the contamination assessment was to model the transport mechanisms and the fate of contaminants identified in the contamination characterization. Fate and transport modeling was begun after the final site analytical data was validated. The results of the contamination assessment are contained in Chapter 5 of this report.

1.3.4 Public Health and Environmental Risk Evaluation

The objective of the Public Health and Environmental Risk Evaluation (PHERE) was to evaluate the potential human health and ecological risks associated with potential exposure to hazardous waste and/or hazardous constituents possibly released from the SWMUs and AOCs at the Site. The PHERE was begun after the final Site analytical data was validated. The PHERE is presented in Chapter 6.

1.3.5 Media Protection Standards

The objective of Media Protection Standards (MPS) is to provide residual, site-related chemical concentrations that are estimated to pose no unacceptable risks to public health or the environment. MPSs are developed only for those chemicals that are predicted in the PHERE to pose unacceptable risks. Soil is the media of primary focus in this RFI report, but groundwater, on-site surface water, and on-site sediment are also addressed. The MPSs are presented in Chapter 6.

1.4 REPORT ORGANIZATION

This report is divided into three volumes. Volume 1 contains the Executive Summary and Chapters 1 through 7. Volume 2 contains References cited in Volume 1 and Appendices for Chapters 1 through 5. Volume 3 contains the PHERE.

Volume 1 (Chapters 1 through 7) - This chapter presented an introduction which included an overview of the project history, the Site history, and the RCRA Facility Investigation (RFI). Chapter 2 presents the results of the physical characterization of the Site. Chapter 3 presents the results of the source characterization which was performed early in the RFI process. Chapter 4 presents the results of the characterization of contamination in groundwater, soil, on-site sediment, and on-site surface water. Chapter 5 presents an assessment of the fate and transport of contaminants. Chapter 6 presents the results of the PHERE and also includes Media Protection Standards. Chapter 7 presents a summary of the results of the RFI and conclusions based on these results.

Volume 2 - This volume contains References cited in Volume 1 and Appendices for Chapters 1 through 5.

Volume 3 - This volume presents the results of the Public Health and Environmental Risk Evaluation (PHERE) as a stand alone document including Media Protection Standards, references, and appendices.

Table 1-1
Former CIBA Site - Cranston, Rhode Island
Project Deliverables Submitted to USEPA

Document Title:	Submittal Date:
Final RCRA Facility Assessment Report (Prepared by Others)	January 1988
RCRA Facility Investigation Proposal, Volumes 1 & 2	March 1990
RCRA Facility Investigation Phase IA Report, Volumes 1 & 2	October 1990
RCRA Facility Investigation Interim Report, Volumes 1, 2, & 3	November 1991
RCRA Facility Investigation Interim Report Phase II Pawtuxet River Proposal	January 1992
Quality Assurance Documents: Supplements	January 1992
Health and Safety Plan, Phase II RCRA Facility Investigation	April 1992
Stabilization Work Plan	August 1992
Draft Stabilization Investigation Report and Design Concepts Proposal	April 1993
Stabilization Investigation Report and Design Concepts Proposal	May 1993
Final Stabilization Design Documents, Volumes 1 through 4	June 1994
Revised Final Stabilization Design Documents, Volumes 1 through 4	January 1995
On-Site Interim Remedial Measures Work Plan	March 1995
On-Site Interim Remedial Measures Draft Contract Documents	April 1995
Pawtuxet River Conceptual Design Work Plan	May 1995

Table 1-2
SWMUs, AOCs, and AAOIs

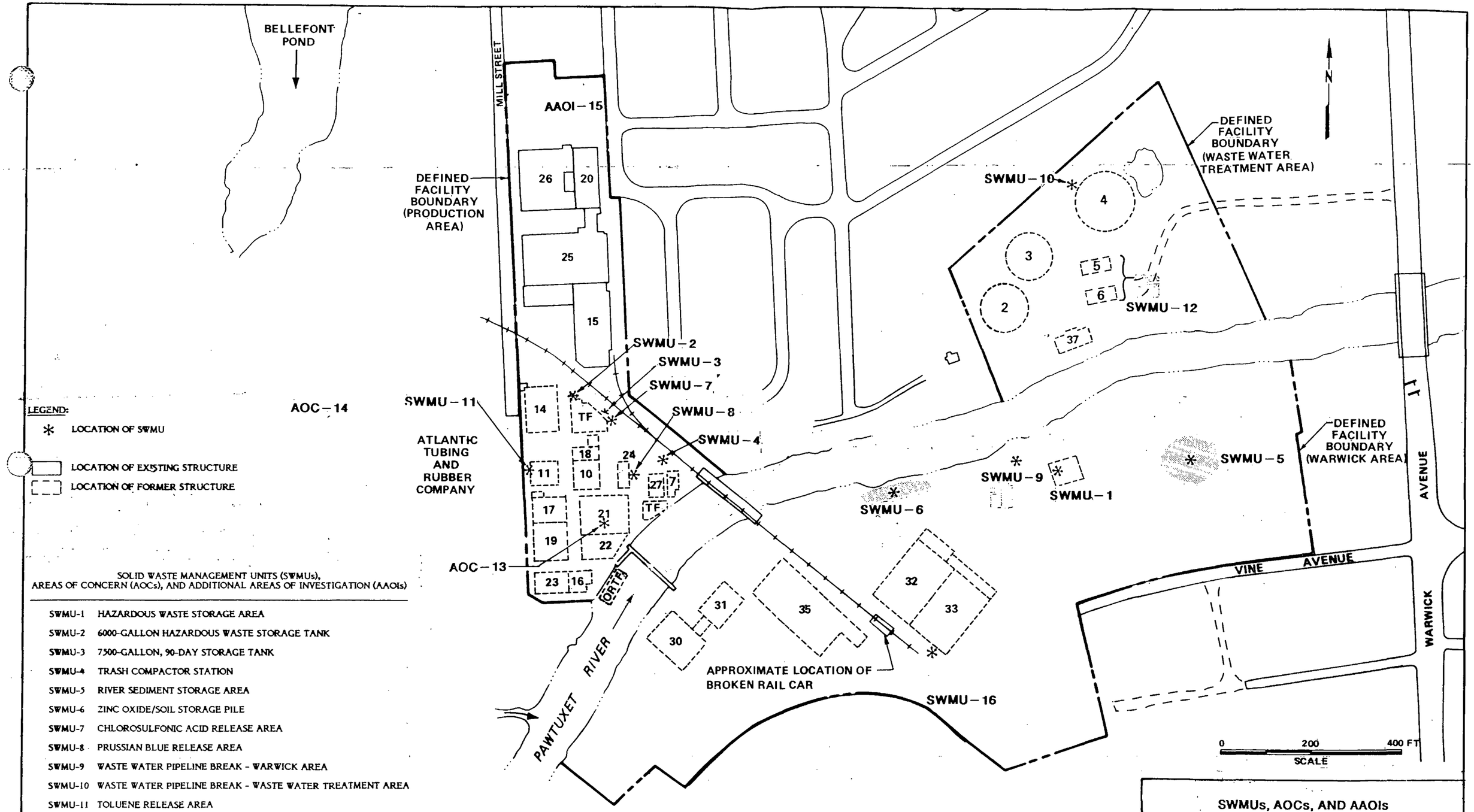
Number	Name	Study Area	Active Dates	Description
SWMU-1	*Hazardous Waste Storage Area*	Warwick	1981 to 1986	SWMU-1 was designed for a maximum capacity of 768 55-gallon drums. Typically, it stored 300 to 400 drums containing various wastes including flammable liquids and solids, corrosive liquids and solids, organic mixtures and solids, non-hazardous organic mixtures, and chloroform. The area was about 42 by 58 feet, and was asphalt-lined, diked, and surrounded by a 6-foot chain-link fence. The dike was capable of holding 48,000 gallons.
SWMU-2	*6000-Gallon Hazardous Waste Storage Tank*	Production	1981 to 1986	SWMU-2 was a carbon steel tank used to store process wastes containing acetone, toluene, monochlorobenzene, isopropanol, naptha, xylene, heptane, methanol, and water. The tank was 17 feet high, 8 feet in diameter, and was enclosed by an 8000-gallon capacity dike (14.5 by 19 by 4 feet).
SWMU-3	*7500-Gallon 90-Day Storage Tank*	Production	1985 to 1986	SWMU-3 was a vertical above-ground tank used to store flammable liquids for periods of less than 90 days. The stainless steel tank was 17 feet high, 8.5 feet in diameter, and was enclosed by a 25,000-gallon dike (about 28 by 29 by 4 feet).
SWMU-4	*Trash Compactor Station*	Production	1972 to 1986	SWMU-4 had two trash compactors (30- and 55-cubic yard capacity) and only handled packaging material, paper wastes, and washed fiber drums. The trash compactor station (21 by 36 feet) was concrete-lined and drained to the Waste Water Treatment Plant.
SWMU-5	*River Sediment Storage Area*	Warwick	1971 to 1976	SWMU-5 contained about 6630 cubic yards of sediment that had been dredged from the Pawtuxet River as part of removing the original cofferdam/waste water outfall. The sediment was removed from the site in 1976; the area's natural grade was restored in 1977.
SWMU-6	*Zinc Oxide/Soil Storage Pile*	Warwick	Late 1960s to present	SWMU-6 has about 25 cubic yards of soil containing about 10% zinc oxide residue; the residue resulted from a broken railcar. The soil pile is about 50 by 7 by 2 feet.
SWMU-7	*Chlorosulfonic Acid Release Area*	Production	1961	SWMU-7 is an area about 10 by 20 feet at which about 500 gallons of chlorosulfonic acid were released.
SWMU-8	*Prussian Blue Release Area*	Production	1956	SWMU-8 is where about 300 cubic yards of blue-stained soil (believed to be stained by the release of an unknown quantity of Prussian Blue) were excavated and removed.
SWMU-9	*Waste Water Pipeline Break — Warwick Area*	Warwick	12 Jan. 1982	SWMU-9 is where a break in the main raw waste transfer line resulted in the discharge of about 24,000 gallons of waste water. The waste water entered the surface water runoff catchment system and discharged to the Pawtuxet River. The waste water typically contained halogenated and non-halogenated solvents and other organic compounds routinely used in the chemical manufacturing process.
SWMU-10	*Waste Water Pipeline Break — Waste Water Treatment Area*	Waste Water Treatment	7 Sept. 1983	SWMU-10 is where a break in an underground waste water line resulted in a discharge of about 50,000 gallons. The discharge flowed into a small pond on-site and then diverted to the Pawtuxet River. The pH of the released waste water was 8.5; the chemical oxygen demand was 1010 parts per million. This discharge contained acetone (31 pounds), isopropyl alcohol (45 pounds), toluene (7 pounds), xylene (1.7 pounds), zinc (0.25 pounds), and nitrobenzene (0.125 pounds).
SWMU-11	*Toluene Waste Water Release Area*	Production	1983	SWMU-11 is where an estimated release of between 9 and 90 pounds of toluene in waste water occurred via a subsurface sump associated with Building 11.

Table 1-2
SWMUs, AOCs, and AAOIs

Number	Name	Study Area	Active Dates	Description
SWMU-12	*Waste Water Treatment Plant*	Waste Water Treatment	1970 to 1983	SWMU-12 is the area formerly occupied by the Waste Water Treatment Plant. Biological trickling towers were used and periodic sump overflows from these towers resulted in discharges to the river. Influent to the towers routinely contained volatile and semi-volatile organic compounds. Additional releases from SWMU-12 in excess of the NPDES permit requirements have been reported for zinc, BOD, and phenols; in two releases, chloroform was discharged to the river.
AOC-13	*Process Building Area*	Production	1930 to 1986	Area in which most of the production activities occurred.
AOC-14	*Atlantic Tubing and Rubber Company Property*	adjacent & west of Production	1981 to present	This property was never used or developed by CIBA-GEIGY.
AAOI-15	*Laboratory Building Waste Water Sump*	Production[1]	1961 to 1987	The sump functioned as part of normal operations in the Laboratory Building. The gravity sump drained to sewer lines that discharged to the publicly owned treatment works.
AAOI-16[2]	*Maintenance Department Cleaning Area*	Warwick	mid-1960s to 1986	Area where maintenance equipment was steam-cleaned. Rinse water drained to a nearby surface water catch basin.

NOTES:

1. CIBA-GEIGY identified the two additional areas of investigation (AAOIs); no releases are known, but the potential for a release existed in the past.
2. AAOI-16 will be redesignated as SWMU-16 for the Phase II investigation.



SOLID WASTE MANAGEMENT UNITS (SWMUs),
AREAS OF CONCERN (AOCs), AND ADDITIONAL AREAS OF INVESTIGATION (AAOIs)

SWMU-1	HAZARDOUS WASTE STORAGE AREA
SWMU-2	6000-GALLON HAZARDOUS WASTE STORAGE TANK
SWMU-3	7500-GALLON, 90-DAY STORAGE TANK
SWMU-4	TRASH COMPACTOR STATION
SWMU-5	RIVER SEDIMENT STORAGE AREA
SWMU-6	ZINC OXIDE/SOIL STORAGE PILE
SWMU-7	CHLOROSULFONIC ACID RELEASE AREA
SWMU-8	PRUSSIAN BLUE RELEASE AREA
SWMU-9	WASTE WATER PIPELINE BREAK - WARWICK AREA
SWMU-10	WASTE WATER PIPELINE BREAK - WASTE WATER TREATMENT AREA
SWMU-11	TOLUENE RELEASE AREA
SWMU-12	WASTE WATER TREATMENT PLANT
AOC-13	PROCESS BUILDING AREA
AOC-14	ATLANTIC TUBING AND RUBBER COMPANY PROPERTY
AAOI-15	LABORATORY BUILDING WASTE WATER SUMP
SWMU-16	MAINTENANCE DEPARTMENT CLEANING AREA

BASE MAP SOURCE: GEOD CORPORATION OF NEWFOUNDLAND, NEW JERSEY, MAPPED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHS. DATE FLOWN: 2 APRIL 1989

SWMUs, AOCs, AND AAOIs

WOODWARD – CLYDE CONSULTANTS

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
WAYNE, NEW JERSEY

DR. BY:	KF	SCALE:	1:2400	PROJ. NO.:	87X4660
CK'D. BY:	MH	DATE:	20 JAN 1992	FIG. NO.:	1-1

2.1 OVERVIEW

This chapter describes the objectives, methods and analyses, and results of the physical characterization. The physical characterization consisted of three main studies: the geologic investigation, the hydrogeologic investigation, and the hydrologic investigation.

Some of the information presented in this chapter has been discussed in detail in documents previously submitted to USEPA. These documents included: the Current Assessment Summary Report (March 1990), the Phase IA Report (October 1990), the Phase I Interim Report (November 1991), and the Stabilization Investigation Report/Design Concepts Proposal (May 1993). The physical characterization data collected throughout the RFI (including the Preliminary Investigation) were used in preparing this chapter, although detailed presentations are generally limited to the data collected during Phase II of the RFI.

Section 2.2 describes the geologic investigation, Section 2.3 describes the hydrogeologic investigation and Section 2.4 presents an overview of the hydrologic investigation of the Pawtuxet River and surrounding areas. As discussed with USEPA, a detailed description of the hydrologic investigation will be presented in the Pawtuxet River RFI Report to be submitted at a later date. A summary of the results of the RFI physical characterization concludes this chapter (Section 2.5).

Phase II Work Proposed but not Performed

Two activities that were proposed for the Phase II Investigation (Phase I Interim Report and Phase II Proposal, May, 1993) were not performed. These were downhole geophysical logging of selected borings by the natural gamma, gamma-gamma, and neutron logging methods, and numerical groundwater flow modeling to simulate the physical groundwater system of the Production Area.

These activities were originally proposed to fill data gaps that were identified during the Phase I Investigation. On the basis of the results of the field studies conducted during the stabilization investigation, however, downhole geophysical logging and numerical groundwater flow modeling were no longer necessary. The data collected during the stabilization investigation satisfied most of the data needs that were going to be addressed with these two activities.

A formal request not to perform the two activities was submitted to the USEPA in May, 1993 and approved by them in July, 1993.

2.2 GEOLOGIC INVESTIGATION

2.2.1 Objectives

The following were the objectives of the geologic investigation:

- develop the background geologic history of the Site and surrounding areas;
- place the Site in its regional stratigraphic and tectonic setting;
- investigate the characteristics of the surface soils, overburden, and bedrock lithology and structure; and
- identify geologic features that might affect the flow of groundwater at the Site.

The results of the investigation were used to develop a geologic model of the Site and to provide a framework for interpreting the results of the hydrogeologic and hydrologic investigations. The geologic model of the Site was refined continuously using new data collected during the various phases of the RFI and the Stabilization Investigation.

2.2.2 Geologic Investigation Methods and Analyses

This section describes the investigation methods and analyses that were used to characterize the geology of the Site. The geologic characterization consisted of the following activities:

- a literature survey;
- reconnaissance mapping;
- a geophysical investigation;
- a subsurface investigation; and
- geotechnical analyses of soil samples.

2.2.2.1 Literature Survey

A literature survey was conducted at the U.S. Geological Survey (USGS) Library in Reston, Virginia to collect geologic information about the Providence, Rhode Island area and the Site vicinity. Relevant geologic information was also obtained from technical journals, geologic maps, field guides, and university reports. The information was used to place the Site in its regional tectonic setting and to provide background information about the geologic history of the area. The sources of geologic information can be found in the References section of this document.

2.2.2.2 Reconnaissance Mapping

In August, 1990, a reconnaissance field investigation was conducted to locate and map bedrock exposures (outcrops) in the vicinity of the Site. The information collected during outcrop mapping was used to infer bedrock structures and lithologies that might underlie the Site, correlate bedrock core samples from the Site with the surrounding bedrock geology, and to help place the Site in a regional geologic framework. Outcrops, however, are not common around the Site area (the closest are over a mile from the Site) and consequently, the mapping only provided indirect information about rock structures underlying the Site.

The outcrops were located by three methods. A review of USGS topographic maps revealed landforms that were suggestive of rock outcrops (e.g., steep topographic gradients suggested that rock cliffs, ledges, or road cuts existed), the geologic map of the Providence, RI Quadrangle (Quinn, 1959) used symbols that showed the location of rock outcrops, and a detailed road log compiled by Hepburn and Rehmer (1981) provided locations of outcrops that were exposed more recently. Most of the outcrops within a 5-mile radius of the Site were visited and mapped. Representative rock samples were collected and compared to bedrock core samples recovered from four Site borings to help infer bedrock geology of the Site.

2.2.2.3 Geophysical Investigation

Geophysical surveys were conducted at the Site in October 1989 and in July 1990. The objectives of the geophysical work were to provide relatively quick and non-intrusive reconnaissance characterization of subsurface conditions. Specifically, the surveys were used to investigate overburden thickness, locate areas of perched water, and to identify shallow man-made and natural subsurface features that might affect groundwater flow.

Three different geophysical surveys were conducted during the RFI. The surveys consisted of a seismic refraction survey, an electrical resistivity survey, and a ground-penetrating radar survey. A detailed description of the geophysical survey activities and survey methods was presented in Chapter 2.0 of the Phase IA Report and in Chapter 2.0 of the Phase I Interim Report. A brief summary of the survey activities and methods is presented below.

The seismic refraction survey aimed at defining refractive horizons, such as the interface between soil and bedrock, in the underlying strata. The refraction data were collected by generating seismic source signals at the surface and recording the return signal on a distant recorder. The survey was conducted in all three study areas to investigate overburden thickness and the depth to bedrock.

The electrical resistivity survey was performed by measuring the resistance to the passage of an electrical current through the subsurface formations. Typically, fluids in the

formation's pore spaces act as conductors so that the survey essentially measures the contrasts in porosity and pore water conductivity between adjacent soil layers. The electrical resistivity data were collected by applying a low-frequency current between electrodes that were driven into the ground. The electrical resistivity survey was conducted in all three study areas to investigate the presence of perched water and to locate soil horizons with contrasting resistivity properties.

The ground-penetrating radar survey was performed to locate subsurface features that might affect groundwater flow. The data were collected by introducing radar pulses into the ground and picking up the reflected signal on a recorder. The ground-penetrating radar survey was used in all three study areas to investigate the location of underground structures such as conduits, building foundations, and buried utilities.

2.2.2.4 Subsurface Investigation

The RFI subsurface investigation was the primary source of information used to develop the stratigraphic and geologic model of the Site. The subsurface investigation consisted of the following activities:

- advancing borings;
- excavating test pits; and
- collecting and classifying soil and rock core samples.

A summary of these activities is presented below.

Advancing Borings

Soil borings were advanced and monitoring wells were installed throughout the RFI. Logs for borings and monitoring wells installed during Phase II of the RFI are included in Appendices 2-A and 2-B, respectively. Logs for borings, piezometers, and monitoring wells installed during investigations prior to Phase II were included in reports previously submitted to the USEPA. A brief summary of the previous investigations is presented below.

Preliminary Investigation- During the Preliminary Investigation, 19 piezometers and 10 monitoring wells were installed at the Site. Boring logs for these piezometers and monitoring wells were presented in the Current Assessment Summary Report.

Phase IA Investigation- During the Phase IA Investigation, 11 piezometers and 4 bedrock monitoring wells were installed. Boring logs for these piezometers and monitoring wells were presented in the Phase IA Report.

Phase IB Investigation- During the Phase IB Investigation, 6 piezometers and 15 monitoring wells were installed. In addition, 23 shallow borings ranging in depth from 2

to 10 feet were advanced to investigate potential contamination associated with individual SWMUs. Boring logs for these piezometers, monitoring wells, and shallow borings were presented in the Phase I Interim Report.

Stabilization Investigation- During the Stabilization Investigation, 14 piezometers, 12 monitoring wells, 4 recovery wells, and 10 vapor extraction wells were installed. Two of the recovery wells (RC-3 and RC-5) and seven vapor extraction wells (VE-4 through VE-10) were installed only after the final Stabilization Investigation report was completed and submitted to the USEPA. Location maps and boring logs of these wells are presented in this report (Figure 2-1 and Appendix 2-A); construction details of the other wells installed during the Stabilization Investigation were presented in the Stabilization Investigation Report/Design Concepts Proposal.

Phase II Investigation- During the Phase II Investigation, 11 monitoring wells were installed. Boring logs and construction logs for these wells are presented in Appendices 2-A and 2-B, respectively. The rationale for the installation of these wells is presented in Table 2-1.

In addition to the borings advanced for monitoring well installation, 43 additional soil borings were advanced to delineate the extent of contamination associated with individual SWMUs. Table 2-2 shows the location and depth of these borings; logs for these borings are presented in Appendix 2-A.

Excavating Test Pits

Six exploratory test pits were excavated at the Site during the Phase IB Investigation. The test pits were excavated in the areas of SWMUs-2, -3, -7, -8, -11 (Production Area), and SWMU-10 (Waste Water Treatment Area) to evaluate shallow subsurface materials and to investigate the presence of contamination potentially associated with the SWMUs. The test pit logs were presented in the Phase I Interim Report.

Collecting and Classifying Soil and Rock Core Samples

During the RFI, soils were sampled from borings using two different techniques - split-spoon sampling and Shelby tube sampling. Bedrock was sampled using rock coring techniques. Sampling procedures were conducted in accordance with the QAPP-Supplement.

Split-spoon Sampling: Continuous split spoon samples were collected during the Phase I and Phase II investigations, in a select number of boreholes.

Shelby Tube Sampling: A total of 24 Shelby tube samples were collected from 16 borings during Phase I of the RFI. These data were presented in the Phase I Interim Report.

Rock Core Sampling: A 5-ft run of rock core was recovered from each of four bedrock borings advanced during Phase IA. The rock core logs were presented in the Phase IA Report.

Logging Methods

Soil Boring Logs:

Soil descriptions were based on observations of soil collected in split-spoon samplers, soil cuttings (drilling spoils), and trimmings from Shelby tube samples. The description and classification of soil samples were performed by a field inspector during the drilling activities and recorded on boring logs. The soil classification procedures are outlined in the QAPP- Supplement.

Rock Core Sample Logs:

Observations made during core drilling were recorded on the core log by the geologist inspecting the operation. Core logging procedures are outlined in the QAPP-Supplement.

2.2.2.5 Geotechnical Soil Analyses

The geotechnical properties of selected soil samples were measured to help investigate the stratigraphy of the Site and to evaluate soil factors that may affect contaminant mobility, soil remediation work, and the groundwater flow regime.

During the Phase I Investigation the following tests were performed:

- index tests: water content and Atterberg limits;
- physical property tests: grain size, total and dry unit weights, porosity, and specific gravity; and
- engineering property tests: vertical hydraulic conductivity.

Index and physical property tests were performed by both International Technology Corporation and Woodward-Clyde Consultants; engineering property tests were performed by Woodward-Clyde Consultants. The results of the Phase I geotechnical analyses were presented in the Phase I Interim Report.

During the Stabilization Investigation, the only geotechnical analyses that were performed were grain size analyses for soil samples collected from recovery wells RC-1 and RC-2 (borings P-32D and P-33D, respectively) and recovery wells RC-3 and RC-5. The analyses were performed to optimize the construction of the recovery wells for the stabilization investigation aquifer tests. The results of the analyses of soil samples collected from recovery wells RC-1 and RC-2 were presented in the Stabilization

Investigation Report (recovery wells RC-3 and RC-5 were not installed before Stabilization Investigation Report was submitted to the USEPA). The grain size distribution curves for soils samples collected from recovery wells RC-3 and RC-5 are presented in Appendix 2-C.

Geotechnical analyses were not performed on soil samples collected during the Phase II Investigation.

2.2.3 Results of the Geologic Investigation

This section describes the results of the RFI geologic characterization in the following order:

- regional geology, as determined by the literature survey and reconnaissance mapping tasks;
- preliminary evaluation of the Site geology, as determined by the results of the geophysical survey; and
- site-specific geology, as determined by the subsurface investigation and the results of the geotechnical analyses of soil samples.

2.2.3.1 Regional Geology

Tectonics and Basement Geology:

The Site is located in the Appalachian Mountain System of southeastern New England. Within the Appalachians, numerous geologic provinces have been delineated on the basis of differences in bedrock radiometric-age dates, rock lithology, fossil assemblages, and rock structure.

The Site is located in a geologic province known as the Avalon terrane, named after the type exposures and similar suites of rocks found on the Avalon Peninsula of Newfoundland (Zartman and Naylor, 1984). This rock belt forms part of the eastern margin of the Appalachian Orogen and can be traced southwestward from Newfoundland, through Massachusetts and Rhode Island, down to South Carolina.

In Rhode Island, the rocks in this terrane are mostly Precambrian and Cambrian (about 600 Ma) volcanic and associated sedimentary rocks that were subsequently intruded by Devonian (about 400 Ma) granites. The rocks are generally unmetamorphosed, or metamorphosed to only a moderate degree. Where exposed, rocks of the Avalon terrane are in sharp fault contact with rock belts found immediately to the east and west (Williams and Hatcher, 1983). Current tectonic models place the evolution of the Avalon crustal block as a separate "micro-continent", that docked against the North American craton sometime after middle Paleozoic time, possibly coincident with the Acadian Orogeny (360 to 400 Ma).

Within the Avalon terrane, the Site is located in a mostly fault-bounded structural basin, the Narragansett Basin, which extends from southeastern Massachusetts to southeastern Rhode Island. The Basin is approximately 18 miles wide from Providence, Rhode Island to Fall River, Massachusetts and 60 miles long from Newport, Rhode Island to Hanover, Massachusetts (Quinn, 1976). About 290 million years ago (the Pennsylvanian Period) the Narragansett Basin was a synclinal depression that received rapid influxes of continental sediments, alluvial deposits, and organic matter from the surrounding highlands (Barosh and Hermes, 1981). These sediments were metamorphosed at low to moderate grades during the Alleghenian Orogeny (the Permian Period), a localized tectonic event that affected rocks of southeastern New England about 275 million years ago (Skehan and Murray, 1980). The southern portions of the basin underwent the most intense deformation, resulting in major tight isoclinal to recumbent north-to-northeast trending folds and numerous north to northwest trending faults (Barosh and Hermes, 1981).

Bedrock Geology and Structure:

The Rhode Island Formation is the dominant bedrock unit in the Narragansett Basin (Figure 2-2). The Formation is composed of sedimentary rocks consisting of gray and black conglomerates, sandstones, shales, and minor amounts of coal. It is estimated to be about 10,000 feet thick (Quinn, 1969; 1971) and about 290 million years old (Skehan and Murray, 1980). The bedding within the Narragansett Basin generally dips east and southeast and strikes mostly north and northeast (Quinn, 1959). Locally, however, the bedding structure is very complex and bedding planes may dip in many different directions because of faulting and folding (Quinn, 1959).

The contact between the rocks of the Narragansett Basin and the rocks of the Avalonian basement is closest west of the Site (about 4 miles away) and it is marked by a relatively steep escarpment (Figure 2-2). The basement rocks, being compositionally more resistant to erosion than the basin rocks, comprise the western upland. The nature of the contact has not been well established, but it is inferred to be a fault along most of the perimeter of the basin (Barosh and Hermes, 1981).

Surficial Geology and Topography:

The Site is located in the Seaboard Lowland section of the New England physiographic province. The topography around the Site area consists of relatively flat plains which slope southeastward and range in elevation from about 40 to 100 feet above sea level (Smith, 1956).

Pleistocene glaciation, which ended about 10,000 years ago, scoured the bedrock surface resulting in the present dominant topographic pattern. Till (unsorted ice-contact deposits) and outwash sediments (meltwater stream-sorted deposits) were deposited

directly over bedrock as the ice receded. Overburden in the area is primarily glacial outwash material consisting of layers of sand, silt, and gravel (Moultrop, 1956). The outwash generally forms thick deposits (up to 280 feet) in low-lying areas while in some upland areas, outwash is not present (Bierschenk, 1959). The average thickness of the outwash plains is about 50 feet (Smith, 1956).

The Pawtuxet River flows along the boundary between the Providence outwash plain to the north and the Warwick outwash plain to the south (Figure 2-3). Although both outwash plains are similar in composition, the Providence outwash plain is younger than the Warwick outwash plain and about 15 to 20 feet lower in elevation (Smith, 1956). Both outwash plains have a downward gradient to the southeast. Currently, the glacial outwash is being eroded and reworked locally by streams and rivers and recent (post-glacial) alluvial deposits cover some areas of glacial outwash.

Surface soils in the area have developed (and are still developing) though chemical and physical weathering processes that acted on the underlying parent material since the last glacial event. The Soil Survey of Rhode Island (USDA, 1981) has mapped three soil types in the Site area. These include Urban land, Rumney fine sandy loam, and Merrimac-Urban land complex. The distribution of these units across the Site is shown in Figure 2-4.

Urban land (Ur) consists of soils in areas that are covered by paved roads, parking lots, or buildings. These areas are typically found heavily developed land that are flat lying or have only moderate slopes. Soils associated with Urban land are excessively to moderately well drained.

The Merrimac-Urban land complex (MU) is a combination of well drained Merrimac soils and areas of Urban land. The complex is typically found on terraces and outwash plains in densely populated areas. Merrimac soils generally have an 8-inch surface layer of dark brown sandy loam, a subsoil of 17 inches of yellowish brown and dark yellowish brown sandy loam, and a substratum of 35 inches or more of a light yellowish brown gravelly sand. Merrimac soils formed in outwash deposits derived from schist, gneiss, and phyllite. The permeability of the Merrimac soils is moderately rapid in the surface layer and upper part of the subsoil, moderately rapid to rapid in the lower part of the subsoil, and rapid in the substratum. The soil is extremely acid through medium acid with a pH ranging from 3.6 to 6.0 (USDA, 1981).

The Rumney fine sandy loam (Ru) is a nearly level, poorly drained soil lying on flood plains. The unit generally has a 5-inch surface layer of very dark grayish brown fine sandy loam, a subsoil of 17 inches of dark grayish brown, mottled fine sandy loam, and a substratum of 35 inches or more of gray and dark grayish brown sand. The permeability is moderately rapid in the surface layer and subsoil and rapid or very rapid in the substratum. The soil is very strongly acid through slightly acid with a pH ranging from 4.5 to 6.5 (USDA, 1981).

2.2.3.2 Preliminary Evaluation of Site Geology - Geophysical Surveys

During the Phase I investigation, three geophysical survey methods - seismic refraction, electrical resistivity, and ground-penetrating radar - were used to provide a quick and relatively non-intrusive method of obtaining preliminary stratigraphic information for each of the three study areas at the Site. A detailed description of the geophysical results can be found in the Phase IA Report and the Phase I Interim Report; a brief summary of the results is presented below.

In the Production Area, the seismic refraction and electrical resistivity data suggested that a glacial till of variable composition and thickness overlies bedrock. Interbedded sands, silts, gravels, and clays overlie the till, but the unit showed no consistent layering. Till is inferred to be 30 to 60 feet below ground surface, while bedrock is inferred to be 50 to 60 feet below the ground surface.

In the Warwick Area, the geophysical data suggest that the soils consist of interbedded and laterally discontinuous sands, silts, and clays. The data indicate that the till varies in thickness and composition and that bedrock is 50 to 60 feet below ground surface.

The geophysical data from the Waste Water Treatment Area are generally consistent with the data collected from the Production and Warwick Areas. The upper 30 feet of overburden consists of interbedded and discontinuous sands, silts, and clays. Till is inferred to be about 30 to 50 feet below ground surface while top of bedrock is inferred to be about 45 to 60 feet below the ground surface.

The geophysical survey results were used to developing a preliminary stratigraphic and geologic model of the Site. As presented in the Phase IA and Interim Reports, the interpreted results of the geophysical data is as follows: bedrock varies from 20 to 90 feet below ground surface but generally ranges from 45 to 60 feet below grade; the overburden consists of sands, silts, clays, gravel, and till; and, the overburden appears to vary widely both in depth and areal extent. Water table depths were inferred to range from 3 to 18 feet below ground surface. Areas of perched water were not identified in the geophysical investigation.

The results of the geophysical survey are generally consistent with the geologic data that was collected by more direct investigation techniques (i.e., drilling, test trenches, etc.). In addition to providing preliminary geologic information for the Site, the geophysical data were used also to help develop the subsurface drilling strategy and to provide subsurface geologic information in areas were borings were not advanced.

2.2.3.3 Site Specific Geology

Surface Soils

There is little correlation of surface soils at the Site with the regional classifications given by the USDA (1981) due to the urbanization of the area. The native soil profile across most, if not all, of the Site has been disrupted by construction, trenching, and backfill activities. Consequently, the surface soils can not be differentiated in detail and, for the purposes of geologic characterization of the Site, are simply considered to be part of the upper-most overburden unit A generalized evaluation of the surface soils at the Site, however, is provided below. The distribution of the USDA (1981) soil map units is shown in Figure 2-4.

The Production Area has a generic regional soil classification of Urban land. In general, the upper few feet of soil in the Production Area consists of sand, silt, and gravel that is mixed with concrete, metal, and other construction debris. None of the material in the Production Area is considered to be native soil.

The western two-thirds of the Warwick Area is covered with asphalt pavement and has a generic regional soil classification of Urban land. The soils below the pavement generally consist of coarse- to fine-grained brown sand, with varying amounts of silt and gravel. These materials may reflect a native soil profile. The soil in the eastern portion of the Warwick Area is classified as Rumney fine sandy loam. The soils in only a localized portion of this area (near SWMU-5) have been investigated in detail. Here, the surface soils consist of fill material containing ashes, brick, and other debris and gray, black, and brown sands with organic material. The organic sands possibly reflect a native soil profile.

The surface soil in the southern half of the Waste Water Treatment Area is classified as Rumney fine sandy loam while the surface soil in the northern half is classified as the Merrimac-Urban Land Complex. The surface soils in this area generally consist of fill material that contains sand, silt, and gravel that is mixed with wood, plastic, asphalt, and other debris although scattered pockets of brown sandy silt and gray sandy silt exist. There is little correlation of the surface soils here to the regional classifications.

Overburden

Five major stratigraphic units have been identified in the overburden underlying the Site; from the top down they are the following:

1. Upper Sand/Fill;
2. Silt;
3. Gravelly Sand (Production Area only).

4. Fine Sand; and,
5. Glacial Till;

These units, as well as other minor units and bedrock, are described below. Quantitative information about each stratigraphic unit is provided by the results of the geotechnical analyses of soil sample collected from each of the major overburden units. A summary of the geotechnical soil properties is presented in Appendix 2-C.

Upper Sand/Fill unit:
Three lithologies - man-made fill, tan sands, and brown silty sands - form the greater part of the upper unit. These lithologies, however, are not differentiated in the geologic cross- sections because these minor units are not laterally continuous for any appreciable distance.

In the Production Area, the upper unit consists primarily of fill. The fill typically consists of concrete rubble and other man-made debris mixed in a sandy matrix.

In the Warwick and Waste Water Treatment Areas, the upper unit consists primarily of brown coarse to fine sands, some silts, and occasional gravel lenses. Fill also occurs locally in the Waste Water Treatment Area.

In the Off-Site areas, the upper portion of the unit consists of tan to yellow, fine to medium-fine sands. In general, the upper unit is thinnest in the Production Area and thickest in the Warwick and Off-Site areas, ranging from about 6 to 29 feet thick.

Silt unit:
In contrast to the diversity of lithologies found in the upper unit, there is a fairly homogeneous unit of gray silt that underlies most of the Site (except in localized portions of the Production Area). This unit consists of gray silt and occasional fine laminations of sand and silty sand (varves). The unit is thickest in the Warwick and Waste Water Treatment Areas, ranging from about 10 to 38 feet thick.

Gravelly Sand unit:
The Gravelly Sand unit occurs only in the Production Area. It is a heterogeneous mixture of gray sand, silt, clay, and gravel. The medium- to coarse-grained matrix contains well-rounded pebbles (gravel) of shale and sandstone, and angular rock fragments of mixed composition. The gravel size ranges from coarse to fine. This unit has a maximum thickness of about 25 feet in the area of monitoring wells MW-10D and MW-12D.

Fine Sand unit:
A relatively homogeneous unit of fine sand and silty sand underlies the Silt unit and has a similar gray color. This unit consists of fine- to very fine-grained sand with varying amounts of silt and occasional traces of clay. The thickness of this unit ranges from about 5 to 37 feet, with an average thickness of 10 to 20 feet. This unit underlies the entire Site except in a small portion of the Waste Water Treatment Area where the Silt unit directly overlies bedrock (near piezometer P-19D).

Glacial Till unit:
A dense, heterogeneous, gray-colored till unit directly overlies bedrock in the Production Area, most of the Waste Water Treatment Area and the western-most portion of the Warwick Area. The Glacial Till unit is composed of a poorly sorted mixture of clays, silts, and coarse sands that contain gravel and rock fragments. The thickness of this unit is fairly consistent averaging about 5 feet but reaching 10 feet in the southwest portion of the Site. This unit also tends to parallel the surface of the underlying bedrock; it is not appreciably thicker where the bedrock surface is deep, nor is it thinner where the bedrock surface is shallow.

Minor Units:

Several minor units occur in the overburden underlying the Site. Occasional lenses of gray fine to coarse sand occur within the Silt unit. These units are not laterally continuous and reflect only minor variations of the Silt unit. Thin lenses of gravelly sands also occur within the Fine Sand unit in the Production Area. A stiff gray silt lens can also be found between the Fine Sand unit and the glacial till in the central portion of the Production Area.

Bedrock
During the Phase I investigation, four borings were advanced into bedrock and several other borings terminated at the top of bedrock. The depth to bedrock was found to be variable across the Site, ranging from 30 to about 90 feet below ground surface. The elevation of the top of bedrock ranges from 5 to 75 feet above mean sea level. The lithologies of the four rock cores did not suggest that a correlation exists between the rock type and the depth to bedrock.

Based on the rock core data (presented in the Phase IA Report), two rock types are present under the Site - a light gray, medium-grained, quartz-biotite sandstone that contains occasional quartzite pebbles, and a dark gray, thin bedded shale with moderately developed phyllitic cleavages. These lithologies correlate with regional descriptions of rocks belonging to the Rhode Island Formation and to the few outcrops exposed nearby.

The sandstone was present all four rock core samples (RW-1 through RW-4). It has poor to moderately developed schistose cleavage with an approximate dip of 65 degrees. Numerous vertical and steeply dipping quartz-filled fractures are present. It is moderately to deeply weathered and moderately strong. Round and elongated pebbles are found in two of the cores.

The shale was present in the core sample recovered from recovery well RW-2. The shale has laminations and very thin bedding with alternating light and dark streaks. The rock has moderately developed sub-horizontal cleavage which dips at approximately 10 degrees. The shale grades into the sandstone in this core sample. A small amount of weathered shale was also recovered in a split spoon sample at location MW-17D at the termination of the boring (Phase I Interim Report).

Geotechnical Properties of the Overburden Units

Geotechnical data for soil samples collected during the different phases of the RFI (Phase IA, Phase IB Round 1, Phase IB Round 2, and Stabilization Investigation) are summarized in Appendix 2-C, Table 2-C1 through Table 2-C5. Tables 2-C1, 2-C2 and 2-C3 summarize the geotechnical data of samples collected during Phase 1 (geotechnical soil samples were not collected during Phase II). Table 2-C4 presents particle size distribution data of soil samples collected during the Stabilization Investigation. Table 2-C5 presents the methods and assumptions used to calculate theoretical hydraulic conductivity values, based on a given sample's grain size distribution, using two established methods - The Hazen method and the Kozeny-Carman method.

The tabulated data are sorted so that the geotechnical properties of the soil samples can be easily referenced and compared by study area, by stratigraphic unit, and by depth. In addition, the average values of the geotechnical data for each stratigraphic unit has been calculated and tabulated.

2.2.3.4 General Site Stratigraphy

Discussion of Geologic Cross-Sections

This section discusses geologic cross-sections of the Site that were developed on the basis of data collected during the RFI subsurface investigation. The locations of the cross-sections are shown in Figure 2-5; cross-sections A through G are shown in Figures 2-6 through 2-8. Four of the cross-sections (A, B, C, and D) intersect and cross the Pawtuxet River and three of the cross-sections are drawn roughly parallel to it (E, F, and G).

A generalized version of the Pawtuxet River is drawn on the geologic cross sections to illustrate the possible relationships between the river, the river sediments, and the

overburden. Although the river cross-sections were drawn on the basis of a compilation of data collected during the Phase I and Phase II River Investigation, these sections are not meant to reflect a precise representation of the river in terms of sediment thickness, surface water elevations, or other physical characteristics.

As discussed in Section 2.2.3.3,the stratigraphy of the Site generally consists of the following top-to-bottom sequence: a brown Sand/Fill unit, a gray Silt unit, a Fine Sand unit, a Glacial Till unit, and bedrock. Cross-section C (Figure 2-6), drawn from the Waste Water Treatment Area southward into the Warwick Area, shows a good example of the "type" stratigraphic section for the Site with very few variations. Major variations of this general stratigraphic sequence, however, do occur in each of the Site areas. A discussion of the stratigraphic cross-sections for each of the Site areas is presented below.

Production Area:

In the Production Area (cross-sections A, B, F, and G) all of the major stratigraphic units are present although significant variations occur. A notable variation is the presence of a relatively wide and thick gravel lens (cross-section B) that underlies the area of monitoring wells MW-10D and MW-4D. Figure 2-9 shows the approximate areal extent and thickness of the Gravel unit in the Production Area. Note that the Gravel unit replaces the Silt unit in this area and potentially acts as a groundwater conduit to the underlying strata. The hydrogeological properties of the Gravel unit and its stratigraphic influence on groundwater are discussed in more detail in Section 2.3.7.1-General Hydrogeological Properties of the Stratigraphic Units.

Minor units in the Production Area include a thin sandy gravel lens within the Fine Sand unit in the central part of the Production Area (cross-sections A and G). It extends from MW-14D to the Pawtuxet River but apparently does not cross the river to the location of piezometer P-27D. The gravel lens is approximately 5 feet thick.

The distribution of the Silt unit is variable in the Production Area, as show in cross-sections A, B, F, and G. In the north-central Production Area (cross section B) the Silt unit is not present; instead the Gravel unit appears to have replaced it. East of the Production Area (cross-sections F and G) the Silt unit thins and disappears, but appears again at the location of piezometer P-24D. The Fine Sand unit, however, as well as the Till unit, is continuous across the Production Area.

The top of bedrock was encountered in only two borings in the Production Area (MW-10D and RW-1). Where encountered, the depth to bedrock varied from 50 to 59 feet below the ground surface (cross-section B).

Off-Site Area:
The Off-Site Area (cross-sections F and D) has the characteristic stratigraphy sequence of a upper brown Sand unit, underlain by a gray Silt unit, overlying a Fine Sand unit with no variations. Till, approximately 5 feet thick, directly overlies bedrock.

Cross-section F shows a bedrock high in the area of RW-4. Here the depth to bedrock is only 28 feet below the ground surface (about 5 feet below mean sea level). Away from RW-4, the bedrock surface slopes steeply down to about 72 feet below ground surface in the area of piezometer P-25D (about 60 feet below mean sea level).

Waste Water Treatment Area:
In the Waste Water Treatment Area (cross-sections C and F), the overburden consists of the characteristic stratigraphic sequence - the upper unit (mostly consisting of brown sand), the gray Silt unit, the Fine Sand unit, Till, and bedrock.

A minor unit consisting of silty fine sand occurs within the Silt unit in the location of piezometer P-23D (cross-section C), but It is only about 5 feet thick and does not extend laterally for any appreciable distance.

The Till directly overlies bedrock across this area except in the location of piezometer P-19D (cross-section F). Here the top of rock is relatively shallow and Till was not encountered in the boring.

The depth to the bedrock surface is most variable in the Waste Water Treatment Area. The depth to bedrock ranges from about 28 feet to 72 feet below the ground surface.

Warwick Area:
Most of the Warwick Area (cross-sections B, C, D, and E) is underlain by the typical stratigraphic sequence consisting of an upper brown Sand unit, the gray Silt unit, the Fine Sand unit, Till, and bedrock.

Minor units in this area include a gray fine sand that occurs between the upper brown Sand unit and the Silt unit (cross-section E). This Fine Sand unit is approximately 8 feet thick and appears only in the area of bedrock well RW-3.

In the area of piezometer P-22D, an isolated unit of interlayered tan sand and gray clay occurs between the upper Sand unit and the Silt unit (cross-section D). This unit is about 10 feet thick but has no appreciable lateral extent.

The distribution of Till in the Warwick Area is variable. The Till unit is found in the western portion of the area (cross-section B) and near the Pawtuxet River (cross-section D). It is apparently not present in the south-central and eastern portions of the Area (cross-section E).

Phase II monitoring wells were installed to supplement the existing monitoring well network. The procedures used to install and develop the Phase II wells were consistent with those used for the previously installed wells. These procedures were described in detail in the Quality Assurance Documents (Volume 2 of the RCRA Facility Investigation Proposal) and in the Quality Assurance Documents: Supplement.

Continuous split-spoon sampling was performed while advancing the borings for each of the deep wells and at each shallow well location that was not in a cluster (i.e. adjacent to a deep well). Well construction logs for each of the Phase II monitoring wells are presented in Appendix 2-B. The remainder of the well construction logs are provided in the Phase IA Report and the Phase I Interim Report.

Seven vapor extraction wells (VE-4 through VE-10) and two groundwater recovery wells (RC-3 and RC-5) were installed for the stabilization activities. Details on the uses and construction of these wells were provided in the Final Stabilization Design Documents.

2.3.2.2 Water Level Monitoring

Groundwater elevations were recorded monthly during Phase II from February 1993 through December 1994. Depth to water readings and groundwater elevations for both Phase I and Phase II are provided in Appendix 2-D. From these data, the groundwater elevations recorded April 29, 1993, July 29, 1993, October 29, 1993, and January 31, 1994 were selected to construct seasonal groundwater elevation contour maps. The contour maps were prepared for both the shallow overburden and the deep overburden. These contour maps are shown in Figures 2-11 and 2-12 and are discussed in Section 2.3.4.1.

Continuous groundwater level measurements (one reading every 30 minutes) were recorded periodically from June 1992 to February 1994 in MW-1S, MW-1D, MW-10S, and MW-10D using an automatic data logger. MW-1S and MW-1D were monitored to evaluate changes in groundwater elevations near the river. MW-10S and MW-10D were monitored to evaluate groundwater elevations further from the river in the Production Area. The results of continuous groundwater level monitoring are discussed in Section 2.3.4.2.

A stilling well was installed in the Pawtuxet River for the Phase II Pawtuxet River investigation. Surface water measurements from July 1992 through January 1993 were reported in the Stabilization Investigation Report and Design Concepts Proposal. Continuous surface water elevation readings from February 1993 through April 1993 are discussed in Section 2.3.4.3.

2.3.2.3 Hydrochemistry

During Phase I, groundwater samples from each of the on-site monitoring wells were analyzed for cations and anions. The ionic concentrations detected were plotted on

trilinear diagrams to determine the hydrochemical facies of the groundwater at the Site using the Piper (1949) method. This graphical method permits a direct comparison of the geochemical nature of groundwater samples, revealing information about the interaction of the different types of groundwater based on their particular geochemical evolution.

The major ion composition of groundwater was characterized using the concentrations of three cationic groups - calcium (Ca^{+2}), magnesium (Mg^{+2}), and sodium and potassium ($Na^{+1}+K^{+1}$) - and three anionic groups - sulfates (SO_4^{-2}), chlorides (Cl^{-1}), and carbonate and bicarbonate ($CO_3^{-2}+HCO_3^{-1}$). The Piper (1944) method, which uses the percentage of the cationic and anionic values plotted on separate trilinear diagrams, is described in full in the Phase I Interim Report.

2.3.2.4 Aquifer Testing

Grain-size Distribution

As part of the Phase I investigations, samples from borings were analyzed for grain size distribution. Results of these analyses were used to estimate hydraulic conductivities. A description of the methodology used in these calculations is provided in the Phase I Interim Report. Hydraulic conductivities estimated from these calculations are summarized in Section 2.3.6.1of this report.

Slug Testing

Slug testing was performed on selected piezometers and wells during Phase I to estimate the hydraulic conductivity of the formation in the immediate vicinity of the screened intervals. Both falling and rising head tests were conducted. The methodology of these tests, as well as the results are presented in the Phase I Interim Report and summarized in Section 2.3.6.1of this report.

Step-drawdown Tests

Step-drawdown tests were performed during stabilization at recovery wells RC-1 and RC-2 (the "test wells") by pumping the test well at a constant discharge rate until drawdown in the well stabilized. The step drawdown test methods and results are described in the Stabilization Investigation Report and Design Concepts Proposal.

The objectives of each step-drawdown test were to:

- determine the optimal rate at which to conduct the 72-hour constant rate test at each recovery well; and
- determine the well efficiency/well loss coefficients.

The step-drawdown tests were conducted in RC-1 on 2 September 1992 and in RC-2 on 3 September 1992. RC-1 was tested at three pumping rates - 20, 38, and 56 gallons per minute (gpm); pumping was performed for about one hour in each of the first two steps and for two hours in the third step. The step-drawdown test at RC-2 was performed at three pumping rates - 6, 12, and 15 gpm; pumping was performed for one hour in the first step and for about 2 hours in each of the other two steps.

Constant Rate Tests

Based on the results from step-drawdown tests, 72-hour constant rate tests were conducted at both RC-1 and RC-2.

The objectives of the 72-hour constant rate tests were to:

- evaluate the aquifer properties (transmissivity, storativity, and hydraulic conductivity) of the Production Area more accurately;
- evaluate the effects of pumping each recovery well on the water level at the bulkhead;
- collect the data needed to design the longer-term (i.e., 30-day) constant rate test; and
- obtain preliminary estimates of pumping rates and schedules appropriate for designing the full-scale groundwater capture system.

The 72-hour constant rate test at RC-2 was conducted from 12 to 15 October 1992 at a pumping rate of 10 gpm for about 74 hours. The RC-1 test was conducted from 26 to 29 October 1992 at a pumping rate of 30 gpm for about 71 hours. The methods for conducting these tests are presented in the Stabilization Investigation Report and Design Concepts Proposal.

The 30-day constant rate test was conducted by pumping both RC-1 and RC-2 simultaneously. In general, the objective of the 30-day constant rate test was to obtain the hydraulic and analytical data needed to optimize the design requirements for the full-scale groundwater capture system. Specifically, the objectives of the 30-day constant rate test were to:

- determine the joint effectiveness (i.e., joint capture zone) of both recovery wells in reversing the hydraulic gradient along the bulkhead;
- determine more precisely the control parameters (e.g., pumping rates, drawdown at the bulkhead) needed for designing the full-scale groundwater capture system;
- collect analytical data showing changes in constituent concentrations over time; and
- determine the impact of subsurface features (e.g., footings, foundations,), changes in stratigraphy, and precipitation on groundwater flow.

The 30-day constant rate test was conducted from 1 through 29 December 1992. The methods and procedures for conducting this test are presented in the Stabilization Investigation Report and Design Concepts Proposal.

2.3.3 Regional and Local Hydrogeology

This section discusses the regional and local hydrogeologic framework which provides the background needed to understand the site-specific hydrogeology.

In the vicinity of the Site, groundwater occurs in the unconsolidated fluvial and glaciofluvial sediments, and in the underlying bedrock. The fluvial deposits are generally thin and discontinuous, and do not typically yield adequate water volumes for wells. The glaciofluvial sediments vary from moderate-to-high yield (75 to 1600 gallons per minute, or gpm) in outwash deposits to poor yield (generally less than 2 gpm) in till deposits (Bierschenk, 1959). The outwash deposits afford most of the water currently pumped and potentially available in the area. Groundwater flow in the unconsolidated deposits tends to follow topography; ultimately, the groundwater discharges to creeks, rivers, and bays. The depth to water in the unconsolidated deposits tends to be a subdued replica of the topography. Groundwater is recharged largely by the infiltration of precipitation. Groundwater levels are above stream levels, indicating that the streams are fed by groundwater (gaining) (Bierschenk, 1959). Typically, limited communication occurs between unconsolidated deposits and bedrock. However, unconsolidated deposits may recharge underlying bedrock.

The yield in bedrock wells is variable depending on such factors as the fracture/joint density and size and the interconnection of fractures/joints. The nature and thickness of overlying deposits also influence the yield of wells in the bedrock. The average yields of bedrock wells in the vicinity of the Site (Narragansett Basin) are about 40 gpm for wells overlain by less than 25 feet of saturated outwash and about 80 gpm for wells overlain by 25 to 100 feet of saturated outwash (Bierschenk, 1959). Groundwater flow direction in bedrock is complicated and depends on fracture/joint orientation, size, and density. The depth to water in bedrock wells reflects the land surface topography. The water level appears to have little relation to the depth at which the water-bearing fractures/joints are encountered, suggesting that there is an interconnection between the unconsolidated deposits and the underlying bedrock.

Taken together, groundwater flow in unconsolidated deposits and bedrock can be viewed as having three components: (1) shallow flow, ultimately discharging to local streams, (2) intermediate flow, ultimately discharging to regional streams, and (3) deep flow, ultimately discharging to a global base level (i.e., either Narragansett Bay or the ocean).

Data on the groundwater features of the Site are discussed in the sections that follow.

2.3.4 Water Level Monitoring

This section describes the water level measurements collected site-wide on a monthly basis and continuously in selected wells. Groundwater contour maps from selected monthly water level measurements are presented. Horizontal and vertical hydraulic gradients and water level trends are also discussed.

2.3.4.1 Monthly Groundwater Levels

This section summarizes monthly groundwater elevation measurements by discussing representative results from the spring, summer, and fall of 1993, and winter of 1994. The discussion is divided into shallow overburden and deep overburden measurements. Groundwater elevation contour maps are provided in Figures 2-10 and 2-11. Vertical gradients for the same periods are provided in Table 2-4.

2.3.4.1.1 Shallow Overburden

Groundwater elevation measurements indicate that, during all seasons, shallow groundwater flow is towards the Pawtuxet River. That is, groundwater flow is from north to south in the Production Area and Waste Water Treatment Area, and from south to north in the Warwick Area. Groundwater elevations in the shallow overburden across the site ranged from roughly 6 to 16 ft above mean sea level (MSL). The highest elevations were measured in the spring and winter. The maximum difference in elevations between seasons was about 1.5 ft. Horizontal gradients ranged from 0.004 at the north end of the Production Area to 0.04 along the bulkhead in the Production Area. In general, horizontal gradients appeared to be steepest in the winter, though seasonal variations are not substantial.

2.3.4.1.2 Deep Overburden

Groundwater elevation measurements indicate that, during all seasons, deep overburden groundwater flow is towards the Pawtuxet River. That is, groundwater flow is from north to south in the Production Area and Waste Water Treatment Area, and from south to north in the Warwick Area. Groundwater elevations in the deep overburden across the site ranged from roughly 7 to 19 ft above mean sea level (MSL). The highest elevations were measured in the spring and winter. The maximum difference in elevations between seasons was about 2 ft. Horizontal gradients ranged from 0.004 in the Waste Water Treatment Area, to 0.02 along the bulkhead in the Production Area. Horizontal gradients appear to be similar during all seasons.

2.3.4.1.3 Vertical Gradients

Warwick

Other than those in SWMU-5, all but one of the overburden well pairs in the Warwick Area showed upward vertical gradients. Overall, the magnitude of the gradients dropped from April 1993 to January 1994, being the highest in April, and the lowest in January, with a slight increase between April and July. Positive vertical gradients ranged from 0.009 to 0.151. In the case of piezometer pair P-26S/P-26D, the gradient shifted from being positive (upward) in April to being negative (downward) in July, October and January. The negative vertical gradients measured in these piezometers ranged from -0.009 to -0.027.

Vertical gradients between shallow and deep overburden, and between deep overburden and bedrock were measured in SWMU-5. In the overburden, vertical gradients were positive (upward). Neither of the overburden pairs measured in this area were measured during all four quarters, but the measurements suggest that an overall decrease in magnitude occurred from April to January. The vertical gradients measured in these pairs ranged from 0.062 to 0.079. The vertical gradients in the deep overburden/bedrock ranged from negative in April (-0.123), to slightly positive in July (0.007), to slightly negative in October (-0.005).

Waste Water Treatment Area

The one overburden well pair (MW-15S/MW-15D) measured in the Waste Water Treatment Area showed an upward vertical gradient. The seasonal variations in this pair was similar to that seen in most of the wells in the Warwick Area - generally decreasing in magnitude from April to January. Vertical gradients measured in this pair ranged from 0.136 to 0.178.

Production Area

Of the 14 overburden well pairs measured in the Production Area, 4 had consistent positive vertical gradients, and 4 had consistent negative vertical gradients. The remaining 6 varied between negative and positive. The vertical gradients measured in the overburden/bedrock pair in this area reversed from positive in April to negative for the remaining three periods. There were no obvious seasonal trends in vertical gradients in the Production Area.

Off Site

Vertical gradients between shallow and deep overburden, and between deep overburden and bedrock were measured in off-site wells and piezometers. In April 1993, one of the off-site shallow/deep overburden pairs (P-20S/P-20D) showed a strong positive gradient (0.61), while the other overburden pair and the overburden/bedrock well pair showed negative vertical gradients. In July, all of the measured pairs had slightly positive gradients. In October and January, the overburden pairs showed negative gradients, while the overburden/bedrock well pair continued to show positive vertical gradients.

Overall, the overburden pair MW-19S/P-24D and the overburden/bedrock pair showed very small vertical gradients (-0.001 to 0.24) which fluctuated from negative to positive, and the overburden pair (P-20S/P-20D) showed a broader range of variation (-0.045 to 0.153).

2.3.4.2 Continuous Groundwater Level Measurements

Groundwater levels measured from June 1992 through December 1992 were discussed in the Stabilization Investigation Report and Design Concepts Proposal. During this monitoring period, groundwater level elevations in MW-1S and MW-1D were relatively stable. The elevations were generally slightly higher in MW-1S than MW-1D. However, this trend was frequently reversed after precipitation events because the deeper overburden at MW-1D is slightly confined, and as such, had a greater response (i.e., a greater increase in hydraulic head) due to the changes in hydraulic pressure caused by infiltration. MW-1D is also screened below the bulkhead and will respond more to changes in the river elevation. Increases in groundwater levels occur shortly after precipitation events that are generally greater than 0.5 inches in 24 hours. Recovery of groundwater levels took from 1 to 10 days after precipitation.

The MW-10S and MW-10D hydrographs for the period of July 1992 through December 1992 are provided in the Stabilization Investigation Report and Design Concepts Proposal. Throughout this monitoring period, these data showed very consistent trends of 1) slightly higher elevations in MW-10S than in MW-10D, and 2) very minor (less than 0.5-foot) increases in elevation in both wells corresponding to rainfall events.

During Phase II, water level monitoring data for MW-1S and MW-1D were collected during the months of February, June, July, and December 1993, and January and February 1994. The hydrographs of these data are presented in Appendix 2-D. (Note: Water levels were not collected continuously during Phase II due primarily to instrument malfunction).

The water level in MW-1S was higher than the piezometric surface elevation of MW-1D during June and July 1993. Toward the end of this monitoring period, there was a reversal with MW-1D having a higher piezometric surface elevation than MW-1S. The December, January, and February 1994 groundwater elevations for MW-1S and MW-1D also showed MW-1D with the higher elevation of the two wells. The groundwater elevations are relatively steady during this period with the recharge from several of the larger precipitation events appearing as spikes on the hydrographs presented in Appendix 2-D.

Water levels were collected continuously during Phase II in MW-10S and MW-10D from February through July of 1993. The hydrographs of these data are presented in Appendix 2-D. In contrast to MW-1S and MW-1D, MW-10S and MW-10D did not respond sharply to recharge from precipitation. Recharge from precipitation events in

MW-10S and MW-10D occur as rounded slopes on the hydrographs. The groundwater elevation increases slowly and levels off generally from 5 to 7 days after a precipitation event. The increase in elevation due to precipitation is generally small, from 0.2 to 0.4 feet. The groundwater elevation difference between MW-10S and MW-10D are smaller than the differences in elevation between MW-1S and MW-1D.

2.3.4.3 Continuous Surface Water Measurements

The elevation of the Pawtuxet River from February 1993 through March 1993 generally varied from about 7 to 13 feet MSL; also, fluctuations in the river of 0.3 to 0.9 feet were noted daily. These daily variations are higher than the variations of 0.1 to 0.3 feet noted during the July 1992 to January 1993 monitoring period. The water level response due to infiltration from precipitation events ranged from less than 0.5 feet to more than a 3 foot increase. As stated in the Stabilization Investigation Report and Design Concepts Proposal, the river response to precipitation is closely mirrored by the corresponding groundwater response in MW-1S and MW-1D. Immediately after a precipitation event there is a rapid rise in the elevation of the river followed by a slower decline. This indicates that the overburden groundwater is interconnected with the water in the river.

In March 1993, the river stage rose 5.5 to 6 feet above normal due to snow melting after the winter. In April 1993, the river stage leveled off at 4 feet above its previously average level. No data are available after April 1993 because the staff gauge was dislodged from its reference point.

2.3.5 Hydrogeochemistry

The results of hydrochemistry analyses show the hydrochemical facies of the groundwater in the shallow overburden aquifer. Samples from the shallow overburden monitoring wells illustrates that there is a dominance of calcium-bicarbonate-type groundwater. The level of bicarbonate dominance suggests that the shallow overburden aquifer receives significant recharge. Groundwater samples such as MW-9S show a change toward both sodium-chloride and sodium-sulphate-type water suggesting a period of longer residence, most likely in a fine-grained material.

The hydrochemical facies of the groundwater in the deep overburden aquifer, as measured by sampling the deep overburden monitoring wells, shows an ionic distribution similar to that of the shallow wells. The similarity of the shallow and deeper overburden results shows good hydraulic connection between the shallow and deep overburden. This connectivity is supported by the chemical similarity of the shallow and deep groundwater.

The hydrochemical facies of the groundwater in the bedrock aquifer, as measured by sampling the bedrock monitoring wells, shows no dominance of any particular ion. The three separate zones (shallow, deep or bedrock) do not show significant differences in major ion distribution.

2.3.6 Aquifer Testing

This section presents a summary of the results of the aquifer testing conducted during Phase I and the Stabilization Investigation as well as a summary of representative values of aquifer characteristics for the stratigraphic units.

2.3.6.1 Phase I Estimates of Hydraulic Conductivity

The hydraulic conductivity estimates obtained from the grain size distribution for the Sand/Fill and Fine Sand units were as follows:

	Hazen Method		Kozeny-Carman Method	
	(ft/day)		(ft/day)	
Unit	Range	Geometric Mean	Range	Geometric Mean
Sand/Fill	28.3 - 86.5	54	1.9 - 6,134	57.2
Fine Sand	0.3 - 150.3	6.8	0.1 - 11,055	7.2

The range of estimates from the Kozeny-Carman method is large and is not representative of the aquifer lithologies observed. Estimates from the Hazen method are more consistent with the range of values observed from in situ testing, but are generally too high.

Overall, the estimates of hydraulic conductivity obtained from grain size distributions are high; the results from in situ testing are much more representative of the hydraulic conductivity at the Site.

Hydraulic conductivities calculated from the Phase I slug tests ranged from 0.013 to 156 feet per day. Possible causes of this large range of values include natural variation in the stratigraphic units and inappropriateness of slug testing to some wells and formations. Theoretically, hydraulic conductivity values generated by the falling head tests should be close to the values generated by the rising head tests. Differences between the values generated by these two test methods suggest the magnitude of error variance possible in these tests. At best, the slug test values should be regarded as approximations of the aquifer properties.

Due to the level of inaccuracy of the Phase I hydraulic conductivity estimates, detailed aquifer testing was conducted during the Stabilization Investigation. These tests are described in the sections that follow.

2.3.6.2 Step-Drawdown Tests

The step drawdown test results showed that the drawdown in RC-1 increased from about 2.0 feet in the 20 gpm step to 3.5 feet in the 38 gpm step and to 4.6 feet in the 56 gpm step. The maximum drawdown was 1.3 feet in P-32S and 2.7 feet in the P-32D (located 9 and 15 feet southeast of RC-1, respectively). Based on these results, a pumping rate of 30 gpm was selected for the 72-hour constant rate test at RC-1.

In RC-2, the maximum drawdown increased from about 7.5 feet in the 6 gpm step to 19 feet in the 12 gpm step to 27 feet in the 15 gpm step. The maximum drawdown was less than 1 foot in the P-33S and P-33D (located 7 and 13 feet southeast of RC-2, respectively). Based on these results, a pumping rate of 10 gpm was selected for the 72-hour constant rate test at RC-2.

The well efficiency/head loss results (calculated using the Hantush-Bierschenk method as described in the Stabilization Investigation Report and Design Concepts Proposal) indicated that 83% of the total head loss in RC-1, and 62% in RC-2, was attributable to laminar flow. These results indicate that RC-1 is very efficient and RC-2 is less efficient. The specific capacity of RC-1 was 9.4 gpm/ft in each of the three steps. The specific capacity of RC-2 ranged from 0.4 to 0.7 gpm/ft from step 1 to step 3. These results suggest that the three pumping rates for RC-1 did not stress the aquifer enough to calculate the maximum potential sustainable drawdown in RC-1. Thus, the well efficiency (83%) calculated for RC-1 may not be accurate. For RC-2, the broader range of specific capacity values reflects both the inefficiency of the well and its low potential yield.

2.3.6.3 72-Hour Constant Rate Tests

RC-1 Test

The drawdown responses from the RC-1 and RC-2 tests are presented in the Stabilization Investigation Report and Design Concepts Proposal. The maximum drawdown measured in RC-1 was 3.76 feet. The maximum drawdown in P-32S (10 feet from RC-1) and P-32D (15 feet from RC-1) was 2.03 and 1.29 feet, respectively. Wells and piezometers close to the bulkhead (P-1S, P-1D, MW-3S, MW-29S, MW-29D, P-29D, MW-30S, MW-30D, and P-30D) generally had a response of about 0.5 feet or less of drawdown.

The cone of influence from pumping RC-1 was relatively flat, fairly circular, and wide. Drawdown was greater in the shallow wells than in the deeper wells, suggesting that the Gravelly Sand and Fine Sand units are hydraulically connected at this location, and that water is being extracted both downward from the shallow aquifer (drawing down the water table) and horizontally from the deep aquifer.

In the vicinity of RC-1, transmissivity values calculated using the Neuman solution in the AQTESOLV™ program (Geraghty and Miller, Inc., 1989) ranged from 0.6 to 3.7 ft^2/min (864 to 5328 ft^2/day); storativity values ranged from 0.001 to 0.05. In the shallow wells, transmissivity values ranged from 0.6 to 2.9 ft^2/min and storativity values ranged from 0.001 to 0.05; in the deeper wells, transmissivity ranged from 1.1 to 3.7 ft^2/min and storativity ranged from 0.001 to 0.004. These transmissivity values are higher than predicted from the Phase I data, but are consistent with the drawdown responses measured during the test. These properties suggest a very transmissive aquifer in the vicinity of RC-1.

RC-2 Test

The results from the 72-hour constant rate test at RC-2 showed a maximum drawdown in RC-2 of 21.63 feet. The maximum drawdown in P-33S and P-33D (located about 7 and 13 feet from RC-2, respectively) was 0.48 and 0.41 feet, respectively. No drawdown was measured in P-1S or P-1D. The drawdown in P-2S was 1.08 feet; drawdown in P-2D was 0.51 feet.

The cone of influence from pumping RC-2 is limited in area. In general, drawdown was slightly greater in the deeper wells than in the shallow wells. This is consistent with the stratigraphy at RC-2 - the Silt unit has a lower permeability than the Sand/Fill and Fine Sand units above and below it, so the Fine Sand unit becomes semi-confined. An exception to this result is at MW-2S - the Transitional Gravel unit above the Fine Sand unit at MW-2S is more transmissive and resulted in more drawdown than at locations where the Transitional Gravel unit was not present (i.e., north and east of RC-2).

In the vicinity of RC-2, transmissivity values ranged from 0.02 to 0.9 ft^2/min and storativity values ranged from 0.001 to 0.16. The transmissivity values are generally lower than predicted from the Phase I tests. However, the RC-2 test results are consistent with the drawdown responses measured during the test and the stratigraphic properties of the units in the vicinity of RC-2.

2.3.6.4 30-Day Constant Rate Test

Hydrogeological Results from the 30-Day Constant Rate Test

Results from the 30-day constant rate test indicated a significant and sharply decreased drawdown after day 10 of the test in both the shallow and the deep overburden wells/piezometers monitored because of the 4 inches of rain that fell from 11 to 14 December 1992. Rapid recharge was measured in the Production Area during and directly after this storm.

Drawdown near the bulkhead from the pumping of RC-1 and RC-2 during the 30-day test varied from 0.15 feet at P-1D to 2.5 feet at P-37S. Pumping both RC-1 and RC-2 simultaneously did not produce convergence (intersection) of the drawdown cones. Two explanations of this non-convergence are possible. First, the stratigraphy present in the vicinity of MW-2S causes much of the drawdown (from pumping RC-2) to propagate toward the more permeable Transitional Gravel unit instead of propagating radially from RC-2. Second, aquifer recharge from precipitation and infiltration counteracted the drawdown after day 10 of the test.

Boundary effects are evident from the drawdown data when the curve of the test data deviates from the theoretically predicted curve (or "type curve"). Possible deviations include 1) a rate of drawdown over time that is higher than predicted suggesting an impermeable boundary (i.e., the bulkhead), and 2) a rate of drawdown lower than predicted suggesting a recharge boundary (i.e., the river). Evaluations of the groundwater level data during the 30-day constant rate test indicate that the bulkhead acts as an impermeable boundary, especially in the shallow units (above the Fine Sand unit). Based on the water level data and responses to pumping RC-1 and RC-2, no other hydraulic boundaries were observed.

Analytical Results from the 30-Day Constant Rate Test

The analytical results from groundwater sampled during the 30-day constant rate test are presented in the Stabilization Investigation Report and Design Concepts Proposal. Two trends are evident in these analytical data:

1. Over time, fairly consistent levels of iron (about 20,000 ppb in RC-1 and 9000 ppb in RC-2) and manganese (about 700 ppb in RC-1 and 1200 ppb in RC-2) were detected in the groundwater samples collected during the 30-day constant rate test.

2. In both RC-1 and RC-2, concentrations of chlorobenzene, toluene, and xylenes increased initially (generally, for the first 2 to 7 days) and decreased gradually over the rest of the 30-day constant rate test; these

results suggest that decreases in these three constituents will continue until a steady state is reached, but is not possible to predict (based on these analytical results) when a steady state would be achieved.

2.3.7 General Discussion of Hydrogeology (Detailed Hydrogeological Model)

This section presents a general discussion of the results of the Phase I, stabilization, and Phase II hydrogeological investigations. This general discussion of the Site hydrogeology is the basis for the detailed Site hydrogeological model. This model is the basis by which On-Site groundwater flow, and the transport of contaminants, are evaluated.

The following Site hydrogeological features are discussed in this section:

- general hydrogeological properties of the stratigraphic units;
- regional groundwater flow influences on Site hydrogeology;
- seasonal and other influences on groundwater elevations;
- horizontal and vertical gradients and flow directions;
- interaction of the groundwater between stratigraphic units;
- interaction of groundwater and the Pawtuxet River;
- groundwater flow rates;
- the effect of manmade features on groundwater flow.

The following sections present the detail on these Site hydrogeological properties.

2.3.7.1 General Hydrogeological Properties of the Stratigraphic Units

This section discusses the general hydrogeologic features of each of the stratigraphic units at the Site. The stratigraphic units are described in Section 2.2.3.3. The following is a description of the hydrogeological features of these units:

Sand/Fill unit - the Sand/Fill unit is the uppermost unit throughout the Site and is characterized by a high degree of variability of the geologic materials present. Precipitation infiltrates directly through this unit, reaching the water table and flowing primarily horizontally. The depth to the water table varies from about 4 to 11 feet below the ground surface yielding a saturated thickness generally ranging from 2 to 9 feet.

In the Production Area, this unit is predominantly silty sand, has a thickness of about 6 to 13 feet, an average transmissivity of 1.22 ft^2/min, and hydraulic conductivity values ranging from 135 to 293 ft/day. The direction of groundwater flow in the Production Area Sand/Fill unit is southeastward, toward the river.

In the Warwick Area, the Sand/Fill unit is composed primarily of poorly graded sands with thicknesses ranging from 10 to 22 feet. The estimated transmissivity of the Sand/Fill unit in the Warwick Area, based on a comparison of properties to that in the Production Area, is 1 to 2 ft^2/min which yields hydraulic conductivity values ranging from 65 to 288 ft/day. The direction of groundwater flow in the Warwick Area Sand/Fill unit is northwestward, toward the river.

In the Waste Water Treatment Area, the Sand/Fill unit is composed primarily of poorly graded sands with thicknesses ranging from 12 to 16 feet. The estimated transmissivity of the Sand/Fill unit in the Waste Water Treatment Area, based on a comparison of properties to that in the Production Area, is 1 to 2 ft^2/min which yields hydraulic conductivity values ranging from 90 to 240 ft/day. The direction of groundwater flow in the Waste Water Treatment Area Sand/Fill unit is southeastward, toward the river.

The Sand/Fill unit is hydraulically connected to the underlying Silt or Gravelly Sand units. Characteristically, the Sand/Fill unit is low yielding due primarily to its limited thickness.

Silt unit - The Silt unit underlies the Sand/Fill unit at most locations on Site. The Silt unit is composed of silt, silty sand, silty clay, and clay and varies in thickness from less than 2 feet in the Production Area to up to 39 feet in the eastern portion of the Warwick Area. The Silt unit is absent only in the northern and eastern portions of the Production Area where the Gravelly Sand unit is present and in some of the off-site areas that were investigated (at locations P-20 S/D and RW-4).

The Silt unit is relatively impermeable in comparison to the Sand/Fill unit above and the Fine Sand unit below it. In most areas where present, the Silt unit acts to semi-confine the underlying Fine Sand unit. This semi-confining pressure generally results in higher piezometric pressure in the deep overburden; which causes an upward hydraulic gradient between the shallow and deep overburden. Vertical hydraulic gradients are discussed in detail in Section 2.3.7.3.

The hydraulic properties of the Silt unit are generally not measured. Based on the responses to pumping RC-1 and RC-2 during the stabilization aquifer tests, it is estimated that the hydraulic conductivity of the Silt unit is at least one to two orders of magnitude lower than that of the overlying Sand/Fill unit or the underlying Fine Sand unit. Vertical transport through the Silt unit is expected to be at least one order of magnitude lower than horizontal transport.

Gravelly Sand unit - The Gravelly Sand unit is present below the Sand/Fill unit in the northern and eastern portion of the Production Area, and in the off-site areas at P-20S/D and RW-4. The extent of the Gravelly Sand unit is described in detail in the Stabilization Investigation Report and Design Concepts Proposal.

The Gravelly Sand unit contains a mixture of sand, silt, clay and gravel. The thickness of this unit in the Production Area varies from less than 1 foot to about 25 feet at MW-12D. The hydraulic properties of this unit were measured from the aquifer test at RC-1 (described in Section 2.4.7.3). The average transmissivity of this unit is 1.09 ft^2/min and the hydraulic conductivity varies from about 60 to 1,570 ft/day.

The Gravelly Sand unit is hydraulically connected to the underlying Fine Sand unit. Where this unit is present, the combined yield of the two overburden units (which is in excess of 100 gallons/min.) is significantly higher than in other areas of the Site.

In most areas this unit receives recharge from the overlying Sand/Fill and Silt units. Groundwater flow in this unit is primarily horizontal, in a southeastward direction toward the river. The piezometric surface in the Gravelly Sand unit varies from about 4 to 11 feet below the ground surface.

Fine Sand unit - The Fine Sand unit is present throughout the Site below the Silt or Gravelly Sand unit. This unit is characterized by the relatively homogeneous nature of the fine and very fine sands and silts. The thickness of the Fine Sand unit varies from about 15 to 45 feet in the Production Area, 5 to 35 feet in the Warwick Area, and about 5 to 37 feet in the Wastewater Treatment Area.

Due to the relatively homogeneous nature of the Fine Sand unit, it is expected that the transmissivity of the unit will fall within the range of average values calculated from the aquifer test data, from 0.58 to 4.05 ft^2/min. The hydraulic conductivity will range from about 20 to 1,150 ft/day.

Flow in the Fine Sand unit is toward the river in each of the Site areas. Groundwater flow in this unit is influenced primarily by the dip of the underlying bedrock and the thickness of the confining Silt unit above it. Both of these factors have an influence on the horizontal and vertical hydraulic gradients measured in this unit.

Till unit - The Till unit is present below the Fine Sand unit throughout most of the Site (except in the eastern portion of the Warwick Area) at thicknesses ranging from 2 to 15 feet. The Till unit overlies the bedrock and is composed of a poorly sorted mixture of materials ranging in size from clay to rock fragments.

The transmissivity and hydraulic conductivity of the Till, while not directly measured, are expected to be much lower than in the overlying Fine Sand unit. These lower hydraulic properties restrict the interaction of the Bedrock and Fine Sand unit groundwater. The Till unit also generally acts as a confining unit for the groundwater in the bedrock which generally results in higher piezometric surface elevations in the bedrock.

Bedrock - The bedrock at the Site is a quartz-biotite sandstone and shale which varies in depth from about 28 feet at P-19D in the Waste Water Treatment Area to 91 feet in the Warwick Area. There have been no measurements of hydraulic properties of the bedrock. The bedrock groundwater has limited interaction with the overburden groundwater due to the presence of the Till confining unit above it, and because of the generally upward gradient between the deep overburden and the bedrock.

The surface elevation of the bedrock is a controlling factor in the flow of groundwater in the overburden. The bedrock highs, which are present in the Waste Water Treatment Area (in the vicinity of MW-15S/D) and in the Off-Site Area (in the vicinity of RW-4), increase the hydraulic gradient. This is shown on the water level contour maps (Figures 2-11 and 2-12).

2.3.7.2 Seasonal and Other Influences on Groundwater Elevations

Groundwater elevations were collected monthly across the Site, and on a continuous basis in selected wells as described in Section 2.3.4.2. The overburden groundwater shows a pattern of fluctuating elevations that are affected by both seasonal influences and precipitation.

Seasonal Influences on Groundwater Elevations

Seasonal influences on groundwater elevations are noted across the Site in a similar manner. The highest groundwater elevations in Phase II were generally noted in the early spring (March and April) which corresponds to the time when recharge from snowmelt and higher average rainfalls are received. The lowest groundwater elevations were generally noted in late summer (August) due to greater evapotranspiration and lower average rainfall.

Seasonal changes in groundwater elevations have essentially no effect on groundwater flow patterns. The seasonal groundwater contour maps of the shallow and deep overburden (Figures 2-11 and 2-12) show the same general pattern of flow toward the river from both the Production and Warwick Area sides.

Seasonal changes in groundwater elevations also have essentially no effect on horizontal and vertical hydraulic gradients. The horizontal gradients remain similar during each season as noted in Section 2.3.4.1. Vertical gradients are also not affected by seasonal groundwater elevation changes, as noted in the data presented in Table 2-4. As such, the predominant upward gradient that is present between the deep overburden and the shallow overburden is not affected by seasonal groundwater changes.

Precipitation Influences on Groundwater Elevations

Groundwater elevations are most sensitive to recharge from precipitation. Recharge is rapid in both the shallow and deep overburden and more pronounced near the river (based on the water level responses to rainfall monitored in MW-1S/D) as compared to those monitored in MW-10S/D). In areas where the deep overburden is semi-confined, the response to recharge in the deeper well is somewhat dampened when compared to the response noted in the shallow well. Further detail on the effects of precipitation on groundwater elevations is provided in Sections 2.3.4.2and in the hydrographs provided in Appendix 2-D.

Atmospheric Pressure Influences on Groundwater Elevations

Changes in water levels in response to changes in atmospheric or barometric pressure were not noted in the shallow or deep wells monitored. Such changes are not expected at the water table because it is at atmospheric pressure and any barometric pressure changes are transmitted in the same manner to the aquifer as they are to the well.

Atmospheric pressure changes were expected to have an effect on water levels in the semi-confined deeper overburden. Generally, in semi-confined aquifers, an increase in barometric pressure would results in a decrease in the piezometric head measured in the well, and visa versa. Such changes were not noted in Site wells. This shows that the deep overburden is hydraulically connected to the shallow overburden and to the river. Since the river and the shallow overburden are at atmospheric pressure, changes in atmospheric pressure are propagated quickly through the deep overburden and into the river and shallow overburden. As such, the deep overburden acts as an unconfined aquifer at the Site with respect to changes in atmospheric pressure.

2.3.7.3 Horizontal and Vertical Gradients and Flow Directions

Groundwater flow in the shallow and deep overburden is directed by two major factors: 1) the presence of the Pawtuxet River which is in direct communication with the overburden groundwater, and 2) the bedrock surface elevation which influences the hydraulic gradient of the water table.

Groundwater flow in the overburden is directed toward the river. Cross-sectional flow diagrams (Figures 2-12 and 2-13) show the relationship of flow in the shallow and deep overburden with the river. The cross-sectional flow diagram along geologic cross-section B (Figure 2-12) shows flow toward the river from both the Production and Warwick Areas.

This diagram also shows the effect of the bulkhead on flow into the river, i.e. the change in vertical flow direction from upward (with discharge into the river) to downward flow around the bulkhead. The bulkhead also directs shallow groundwater flow into the

deeper Fine Sand unit before it is discharged into the Pawtuxet River. The bulkhead also affects the placement of the equipotential lines, as shown on Figure 2-12, by shifting them towards the Warwick Area. Without the presence of the bulkhead, these equipotential lines would be expected to align directly under the river.

Cross-sectional Flow Diagram C is shown on Figure 2-13. This section shows flow from the Waste Water Treatment Area and the Warwick Area going into the river, without the influence of the bulkhead. This diagram also shows the effect of the bedrock surface elevations on groundwater flow. The relatively sharp decrease in the surface elevation of the bedrock from the Waste Water Treatment Area to the Warwick Area affects the vertical flow component as shown by the plunging equipotential lines in the Warwick Area. Under conditions where the bedrock surface elevation is relatively flat (as shown in Section B, Figure 2-12), the equipotential lines would be mirror images on both sides of the river.

Hydraulic gradients for horizontal and vertical flow have been calculated using the data presented in each of the four seasonal flow diagrams (Figures 2-10 and 2-11). A summary of the range of hydraulic gradients calculated are as follows:

Hydraulic Gradients	Production Area	Warwick Area	Waste Water Treatment Area
Horizontal-Shallow Water Table	0.004 to 0.04	0.005 to 0.01	0.01 to 0.02
Horizontal-Deep Overburden	0.005 to 0.02	0.002 to 0.008	0.006 to 0.01
Vertical-Shallow/Deep Overburden	0.001 to 0.08	0.009 to 0.151	0.136 to 0.18

Shallow and deep horizontal hydraulic gradients in the Production Area were lowest in the northern portion and highest near the bulkhead. The vertical hydraulic gradients in the Production Area were generally upward in the northern portion and downward in the vicinity of the river. This consistent trend of groundwater gradients shows the following for the Production Area:

- the bulkhead is a major influence on groundwater flow - it steepens the shallow horizontal gradient and reverses the vertical gradient in its vicinity;
- the overburden groundwater is hydraulically connected to the river; and
- there is limited to no interaction with the bedrock groundwater

In the Warwick Area, the water table horizontal hydraulic gradients were lowest in the southern portion and highest near the river. The predominant upward vertical gradient in the Warwick Area also shows the interconnection of the overburden groundwater with the river and the lack of interaction with the bedrock groundwater. Groundwater in the Waste Water Treatment Area behaves similarly to that in the Warwick Area.

2.3.7.4 Interaction of Groundwater Between Stratigraphic Units

The interaction of groundwater between the stratigraphic units was evaluated from the groundwater elevation data and the aquifer test results. Groundwater in the overburden behaves essentially as one unit, i.e., the Sand/Fill, Silt, and Fine Sand units are hydraulically interconnected. The degree that the overburden units are interconnected varies at different locations of the Site, dependent primarily on the presence, thickness, and composition of the Silt unit.

In the Production Area where the Silt unit is relatively thin (up to about 15 feet thick) or absent, and is composed of variable percentages of sand, the hydraulic interconnection between the Sand/Fill and Fine Sand units is greater. This was proven in the constant rate aquifer tests where the Silt unit acted as a leaky confining unit, i.e. water migrated from the Silt unit to the Fine Sand unit when it was pumped. In the Warwick Area where the Silt unit is thickest (up to about 40 feet) and generally has a higher percentage of clay, the hydraulic connection between the shallow and deep overburden is expected to be less.

There is limited hydraulic connection between the Fine Sand unit and bedrock. This is based on the presence of the Till unit which was found in each deep boring with the exception of the borings advanced for the following well clusters: MW-6S/P-18D/RW-3, MW-17S/D, P-22S/D, and MW-19S/P-24D.

The Till unit restricts the hydraulic connection between the overburden and bedrock in two ways. First, the Till unit has a lower permeability than the overlying deep overburden, thus reducing the potential for groundwater to move downward and through it. Second, the Till unit generally acts to confine or semi-confine the underlying bedrock aquifer. The confining/semi-confining pressure caused by the overlying Till unit results in higher piezometric pressure in the bedrock aquifer, which results in either an upward vertical hydraulic gradient between the deep overburden and bedrock aquifer or a piezometric surface elevation in the bedrock that is higher than the surface elevation of that unit.

As presented in the Revisions to the Phase I Interim Report and Phase II Proposal, July 1993, the vertical gradients are predominately upward, indicating that groundwater in the shallow overburden is not migrating downward into the bedrock. In general, these upward vertical gradients are consistent in each of the water level measurement rounds.

2.3.7.5 Interaction of Groundwater and the Pawtuxet River

Groundwater in the overburden units is hydraulically interconnected to the Pawtuxet River. The groundwater flow directions and general upward hydraulic gradients clearly show this interconnection. The direction of groundwater flow, the hydraulic gradients, and the influence of the bulkhead on groundwater flow were discussed in other parts of this Section. The rapid response to rainfall in the aquifer, the in-river wells, and the river, also shows the interconnection of the overburden groundwater with the river. Similar changes in water level elevations were noted both on a seasonal basis and in response to precipitation events. This is discussed in the previous reports, and in the hydrographs in Appendix 2-D.

The volume of groundwater that flows from the Production Area into the Pawtuxet River was estimated using the following flow net analysis:

$$Q = (mKH/n)(dm/ds)$$

where:

Q = flow net discharge rate
m = number of flow tubes
K = hydraulic conductivity
H = head drop across the region of flow
n = number of divisions of head in flow net
dm/ds = ratio of vertical to horizontal scales of flow net

From the stabilization aquifer tests, transmissivity and storativity data for each of the overburden units were generated. The transmissivities (T) values of each unit were used to calculate the hydraulic conductivity (K) of the unit.

The results of the flow net analysis are as follows:

1) The Gravelly Sand unit in the Eastern Portion of the Production Area:

T = 1.22 ft^2/min, b = 7 ft, therefore: K = 0.17 ft/min = 245 ft/day
m = 1
n = 5
H = 5 ft
dm/ds = 10 ft/100 ft = 1/10

Q = (1 [245 ft/day] 5 ft/5)(1/10) = 24.5 ft^3/day/ft along river

Therefore, the groundwater flow from the Gravelly Sand unit of the Production Area into the river is 24.5 ft^3/day/ft along the river times 220 feet of river frontage = 5390 ft^3/day. Since the Gravelly Sand unit represents about 42% of the upper flow tube in this part of the Production Area as shown in geologic section B (Figure 2-17), the total flow from this unit is 42% of 5,390 ft^3/day or 2,246 ft^3/day.

2) The Fine Sand unit in the Eastern Portion of the Production Area:

T = 1.68 ft^2/min, b = 45 ft, therefore: K = 0.04 ft.min = 58 ft/day
m = 3
n = 6
H = 6 ft
dm/ds = 10 ft/100 ft = 1/10

Q = (1 [58 ft/day] 6 ft/6)(1/10) = 17.4 ft^3/day/ft along river

Since the upper flow tube of Section A *(or B)* is 42% Gravelly Sand which is accounted for in 1), the remaining 58% is Fine Sand. Subtracting 42% of the flow estimated from the upper flow tube reduces the total flow from the Fine Sand unit to 15.0 ft^3/day/ft along this portion of the river. Therefore, the groundwater flow from the Fine Sand unit in geologic section B into the river is 15.0 ft^3/day/ft times 220 feet of river frontage = 3,300 ft^3/day.

3) The Sand/Fill unit in the Western Portion of the Production Area:

T= 0.91 ft^2/min, b = 8 ft, therefore: K = 0.11 ft/min = 158.40 ft/day
m = 1
n = 2
H = 2 ft
dm/ds = 10 ft/50 ft =1/5

Q = (1 [158.4 ft/day] 2 ft/2)(1/5) = 31.68 ft^3/day/ft along river

Therefore, the groundwater flow from the Sand/Fill unit of geologic section A (Figure 2-6) into the river is 31.68 ft^3/day/ft times 250 feet of river frontage = 7,920 ft^3/day.

4) The Fine Sand unit in the Western Portion of the Production Area:

T = 0.27 ft^2/min, b = 37 ft, therefore: K = 0.007 ft/min = 10.1 ft/day
m = 2
n = 2
H = 3 ft
dm/ds = 10 ft/50 ft =1/5

Q = (2 [10.1 ft/day] 3 ft/2)(1/5) = 6.06 ft^3/day/ft along river

Therefore, the groundwater flow from the Fine Sand unit in geologic section A into the river is 6.06 ft^3/day/ft times 250 feet of river frontage = 1515 ft^3/day.

The total flow from the overburden groundwater of the Production Area into the Pawtuxet River is obtained by adding the discharges of each of the four units of the two sections.

This total is 14,981 ft^3/day or 112,058 gallons/day (**15,000 ft^3/day** or 112,000 gallons/day rounded).

Since aquifer tests were not conducted in the Warwick and Waste Water Treatment Areas, the discharge of groundwater from the overburden units into the river from these areas was estimated based on the size of the discharge area (i.e. shoreline) relative to that of the Production Area. The similarities of the overburden properties in the Site areas makes this assumption reasonable. This estimate yields a discharge of **45,000 ft^3/day** for the Warwick Area and **15,000 ft^3/day** for the Waste Water Treatment Area -336,000 and 112,000 gallons/day, respectively.

2.3.7.6 Groundwater Flow Rates

Groundwater flow was estimated from the aquifer tests conducted in the Production Area during stabilization. Based on these tests and the similarity of the properties of the stratigraphic units in the different Site areas, the following are the range of transmissivity, storativity, and hydraulic conductivity values for the overburden units:

Aquifer Values	Sand/Fill unit	Fine Sand unit
Transmissivity (ft^2/min)	1.1 to 1.2	0.60 to 4.1
Storativity (unitless)	0.004 to 0.24	0.003 to 0.005
Hydraulic Conductivity (ft/day)	176 to 864	19 to 1180
Velocity (ft/day)	6 to 28	0.6 to 38

The velocity (v) is calculated from $v = Ki/n$, where i is the average horizontal hydraulic gradient in the shallow and deep overburden across the Site (0.008) and n is the average porosity (0.25) of the Sand/Fill and Fine Sand units as presented in the Phase I Interim Report.

These values show a wide range of properties for the overburden units at the Site. This is reflective of the varying composition and thicknesses of these units as discussed in Section 2.2.3.3and 2.3.7.1.

2.3.7.7 Effects of Manmade Features on Groundwater Flow

Manmade features that are present on the Site were evaluated for their effect on groundwater flow. These features include the bulkhead in the Production Area, the buried structures in the Production Area, and the pavement present on several portions of the Site.

The effects of the bulkhead on groundwater flow were previously discussed. The bulkhead generally causes groundwater elevations in the shallow overburden to be artificially high which causes a downward gradient near it. This downward gradient reverses groundwater flow which results in groundwater flowing from the Sand/Fill unit into the deeper Fine Sand unit and then into the river.

The structures that were present in the Production Area when the Site was active were demolished in-place. Those structures that contained basements were generally filled with the construction rubble from the demolished buildings. The effect of these buried debris-filled basements on groundwater flow is believed to be minimal since these basements are predominantly above the water table.

Several areas on Site are paved with asphalt or concrete. These areas represent a minor percentage of the total available space. Since the effect of precipitation recharge on groundwater elevations was rapid across the Site, the pavement does not have any measurable effect on the response to recharge from precipitation. This is due to the discontinuous nature of the pavement present and its poor overall integrity.

2.3.8 Summary of Site Hydrogeology

This section described the objectives, methods, analyses, and results of the hydrogeological investigations and presented the detailed hydrogeological model based on those results. The following conclusions on the Site hydrogeology formed the basis of this model:

- groundwater that is present in the Sand/Fill, Silt, Gravelly Sand, and Fine Sand, units are generally hydraulically interconnected;
- the Silt unit acts to semi-confine the underlying Fine Sand unit. The amount of confining pressure present depends on the thickness and composition of the Silt unit;
- the Silt unit is best described as a leaky confining unit based on the aquifer tests;
- the Till unit is present across most of the Site and is characteristically low in permeability;
- the overburden units are hydraulically connected to the Pawtuxet River
- groundwater in the shallow and deep overburden flows toward the river from both the Production Area and Warwick Area sides;

- the bedrock is semi-confined or confined across the Site based on its potentiometric surface elevation which is higher that the surface elevation of the bedrock;

- the bedrock is not believed to be hydraulically connected to either the overburden units or the Pawtuxet River;

- high bedrock surface elevations create higher hydraulic gradients, especially in the shallow overburden. This is especially prominent in the Southern end of the Waste Water Treatment Area;

- groundwater elevations are influenced primarily by recharge from precipitation - a rapid response from precipitation is noted in the shallow overburden, the deep overburden, and in the river;

- about twenty five percent of the rainfall may contribute to recharge;

- groundwater hydrochemistry is similar in both the deep and shallow overburden in the Production Area indicating that the overburden aquifer system behaves as an unconfined aquifer and receives significant recharge from precipitation;

- there are minimal seasonal influences on groundwater elevations;

- hydraulic gradients between the shallow and deep overburden are predominantly upward, with the exception of wells near the bulkhead in the Production Area;

- the bulkhead acts to reverse the vertical hydraulic gradient near it - this results in groundwater flowing under the bulkhead and being forced toward the Warwick Area bank of the river;

- groundwater discharges into the Pawtuxet River at estimated rates of 15,000 ft^3/day each in the Production and Waste Water Treatment Areas, and 45,000 ft^3/day in the Warwick Area;

- groundwater flow velocities range from 6 to 28 feet/day in the Sand/Fill and Gravelly sand units and 0.6 to 38 feet/day in the Fine Sand unit;

2.4 HYDROLOGY

2.4.1 Overview

A hydrologic investigation of the Pawtuxet River was conducted during Phases I and II of the RFI. The purpose of the hydrologic investigation was to evaluate the physical and chemical characteristics of the river with respect to storage and transport of constituents of contaminants. The methods used to complete the hydrologic investigation included a literature review, flow characterization studies, evaluation of river bathymetry, measurement of sediment physical characteristics and development of hydrodynamic and sediment transport models for the river. Details on these investigatory methods and the results of the investigation will be provided in the Pawtuxet River RFI Report (to be submitted at a later date).

Table 2-1 Purpose and Placement of Wells Installed During Phase II

Well ID	Area	SWMU Relationship	Purpose
MW-35S	Off-Site	Background	define stratigraphy of Production Area and hydrogeology related to water entering the site
MW-4D	Production Area	SWMU-11	define gravel unit boundaries and hydrogeology related to vertical and horizontal extent of contamination downgradient of SWMU-11
MW-14D	Production Area	SWMU-11	define gravel unit boundaries and hydrogeology related to vertical and horizontal extent of SWMU-11 contamination
MW-34S	Production Area	SWMU-11	define hydrogeology of SW Production Area downgradient of SWMU-11
MW-34D	Production Area	SWMU-11	define stratigraphy of SW Production Area and hydrogeology related to horizontal and vertical extent of contamination from SWMU-11
MW-11D	Warwick Area	SWMU-5	define stratigraphy of Warwick Area and hydrogeology related to vertical extent of contamination in SWMU-5
MW-26S	Warwick Area	SWMU-5	define overburden stratigraphy in Warwick Area and hydrogeology downgradient of SWMU-5
MW-27S	Warwick Area	Background	define overburden stratigraphy in the Warwick Area and hydrogeology related to groundwater entering the site
MW-28S	Warwick Area	Background	define overburden stratigraphy in the Warwick Area and hydrogeology related to groundwater entering the site
MW-32S	Warwick Area	SWMU-16	define overburden stratigraphy and hydrogeology downgradient of SWMU-16
MW-25S	W. W. Treatment	SWMU-12	define overburden stratigraphy in Waste Water Treatment Area and hydrogeology downgradient of SWMU-12
RC-3 *	Production Area	Production Well	production well installed as part of Stabilization investigation and groundwater treatment system
RC-5 *	Production Area	Production Well	production well installed as part of Stabilization investigation and groundwater treatment system
VE-4 *	Production Area	SWMU-11	vapor extraction well installed as part of soil vapor extraction system
VE-5 *	Production Area	SWMU-11	vapor extraction well installed as part of soil vapor extraction system
VE-6 *	Production Area	SWMU-11	vapor extraction well installed as part of soil vapor extraction system
VE-7 *	Production Area	SWMU-11	vapor extraction well installed as part of soil vapor extraction system
VE-8 *	Production Area	SWMU-11	vapor extraction well installed as part of soil vapor extraction system
VE-9 *	Production Area	SWMU-11	vapor extraction well installed as part of soil vapor extraction system
VE-10 *	Production Area	SWMU-11	vapor extraction well installed as part of soil vapor extraction system

Notes: * wells installed as part of Stabilization Investigation - they have not been previously reported and will appear as part of this report.

Table 2-2 Phase II Boring* Locations and Depth

Boring ID	Well ID (If installed in boring)	SWMU Location	Total Depth (feet)
B-BGA	MW-35S	Background	18
B-BGB	--	Background	14
B-BGC	MW-27S	Background	18
B-BGD	MW-28S	Background	16
B-2E	--	SWMU-2	8
B-2F	--	SWMU-2	8
B-2G	--	SWMU-2	8
B-3E	--	SWMU-3	8
B-3F	--	SWMU-3	8
B-3G	--	SWMU-3	4
B-3H	--	SWMU-3	8
B-3I	--	SWMU-3	14
B-5A	--	SWMU-5	4
B-5B	--	SWMU-5	4
B-5C	--	SWMU-5	4
B-5D	--	SWMU-5	12
B-5E	--	SWMU-5	4
B-5F	MW-26S	SWMU-5	16
B-7D	--	SWMU-7	8
B-7E	--	SWMU-7	8
B-7F	--	SWMU-7	8
B-7G	--	SWMU-7	8
B-7H	--	SWMU-7	8
B-8D	--	SWMU-8	8
B-8E	--	SWMU-8	6
B-8F	--	SWMU-8	8
B-8G	--	SWMU-8	6
B-8H	--	SWMU-9	10
B-9A	--	SWMU-9	6
B-9B	--	SWMU-9	6
B-10F	--	SWMU-10	2
B-10G	--	SWMU-10	2
B-10H	--	SWMU-10	2
B-12A	--	SWMU-12	12
B-12B	--	SWMU-12	6
B-12C	--	SWMU-12	6
B-12D	--	SWMU-12	6
B-12E	MW-25S	SWMU-12	17
B-13A	--	SWMU-13	8
B-16B	--	SWMU-16	6
B-16C	--	SWMU-16	6
B-16D	--	SWMU-16	11
B-16E	--	SWMU-16	13
B-DT1	--	Dowtherm	28
B-DT2	--	Dowtherm	32
B-DT3	--	Dowtherm	28
B-DT4	--	Dowtherm	28
B-DT5	--	Dowtherm	28

Note: * This list contains borings advanced for the purpose of collecting analytical soil samples, and does not include borings advanced for geologic characterization and well placement, except where indicated.

Table 2-3
Piezometer and Well Location and Construction Details

Well/ Piezometer Number	Area	Month/ Year of Installation	Radius of Riser	Monitoring Well/Piezometer Data											
				Location Data		Elevation Data		Boring Data		Bottom of Monitoring Zone		Top of Monitoring Zone			
				Northing	Easting	Ground Surface	Top of Riser Pipe	Depth	Bottom Elevation	Depth	Elevation	Depth	Elevation	Length of Screen	Strata Monitored
EP-1	Production	before 4/88	—	249031.39	524120.01	21.64	22.90	14.19 (h)	7.45	—	—	—	—	—	—
EP-2	Off-Site	before 4/88	—	249529.36	523682.09	23.05	24.52	12.93 (h)	10.12	—	—	—	—	—	—
EP-5	Warwick	before 4/88	—	248882.06	525340.61	12.52	15.84	5.68 (h)	6.84	—	—	—	—	—	—
EP-6	Warwick	before 4/88	—	249162.41	525281.88	10.17	11.04	4.13 (h)	6.04	—	—	—	—	—	—
EP-7	Warwick	before 4/88	—	248686.32	524961.77	14.09	14.45	5.84 (h)	8.25	—	—	—	—	—	—
EP-8A	Off-Site	before 4/88	—	249192.54	523548.92	18.57	19.91	7.46 (h)	11.11	—	—	—	—	—	—
EP-8B	Off-Site	before 4/88	—	249280 (i)	523180 (i)	21.32	24.41	6.91 (h)	14.41	—	—	—	—	—	—
CURRENT ASSESSMENT SUMMARY REPORT															
P-1S	Production	4/88	1-1/4"	248838.37	523997.61	13.57	16.41	NA	NA	10.00	3.57	7.00	6.57	3.00	Fill
P-1D	Production	4/88	1-1/4"	248841.66	523999.27	13.59	16.33	49.50	-35.91	43.00	-29.41	40.00	-26.41	3.00	UD
P-2S	Production	4/88	1-1/4"	248685.97	523887.35	12.70	13.85	NA	NA	11.00	1.70	8.00	4.70	3.00	Fill
P-3S	Production	4/88	1-1/4"	248942.37	524128.06	14.30	15.45	NA	NA	11.50	2.80	8.50	5.80	3.00	Fill
P-4S	Production	4/88	1-1/4"	249042.14	523768.11	18.97	19.92	NA	NA	18.00	0.97	15.00	3.97	3.00	UD
P-5S	Production	4/88	1-1/4"	249030.59	523912.45	18.43	21.18	NA	NA	16.00	2.43	13.00	5.43	3.00	UD
P-6S	Production	4/88	1-1/4"	249111.64	524015.45	21.53	23.62	NA	NA	18.00	3.53	15.00	6.53	3.00	UD
P-6M	Production	4/88	1-1/4"	249091.36	524013.09	21.28	21.80	NA	NA	40.00	-18.72	37.00	-15.72	3.00	UD
P-7S-A	W. Water	4/88	1-1/4"	249327.86	525323.32	14.73	16.26	NA	NA	9.00	5.73	6.00	8.73	3.00	UD
P-7S-B	W. Water	4/88	1-1/4"	249339.03	525320.60	14.63	15.68	NA	NA	14.00	0.63	11.00	3.63	3.00	UD
P-8S	W. Water	4/88	1-1/4"	249180.78	524849.59	15.04	16.21	NA	NA	11.50	3.54	8.50	6.54	3.00	UD
P-9S	W. Water	4/88	1-1/4"	249434.49	524997.15	14.88	16.10	NA	NA	12.00	2.88	9.00	5.88	3.00	UD
P-11S	W. Water	4/88	1-1/4"	249627.05	525025.11	14.50	17.95	NA	NA	10.00	4.50	7.00	7.50	3.00	NE
P-12S-A	W. Water	4/88	1-1/4"	249371.03	524763.23	14.21	15.29	NA	NA	12.00	2.21	9.00	5.21	3.00	NE
P-12S-B	W. Water	4/88	1-1/4"	249372.42	524766.81	14.21	15.32	NA	NA	15.00	-0.79	12.00	2.21	3.00	NE
P-10S	Warwick	4/88	1-1/4"	249083.97	524985.17	12.50	14.05	NA	NA	12.00	0.50	9.00	3.50	3.00	UD
P-13S	Production	4/88	1-1/4"	249521.49	523773.93	23.82	26.99	NA	NA	14.00	9.82	11.00	12.82	3.00	NE
P-14S	Production	4/88	1-1/4"	249789.33	523852.83	23.74	24.18	NA	NA	13.00	10.74	10.00	13.74	3.00	UD
P-14D	Production	4/88	1-1/4"	249786.61	523846.62	23.68	23.95	58.50	-34.82	50.00	-26.32	47.00	-23.32	3.00	Till
MW-1S	Production	5/88	4"	248849.44	523990.88	13.14	15.04	NA	NA	13.00	0.14	3.00	10.14	10.00	Fill
MW-1D	Production	5/88	4"	248852.28	523985.86	13.93	16.28	50.00	-36.07	48.00	-34.07	38.00	-24.07	10.00	UD
MW-2S	Production	5/88	4"	248697.91	523904.81	12.56	14.46	20.00	-7.44	18.00	-5.44	8.00	4.56	10.00	Fill

S: 87x4660\rfirpt\tablee\CONSTR.XLS
7/28/95 9:43 PM

Table 2-3
Piezometer and Well Location and Construction Details

Well/ Piezometer Number	Area	Month/ Year of Installation	Radius of Riser	Location Data		Elevation Data		Monitoring Well/Piezometer Data							
								Boring Data		Bottom of Monitoring Zone		Top of Monitoring Zone			
				Northing	Easting	Ground Surface	Top of Riser Pipe	Depth	Bottom Elevation	Depth	Elevation	Depth	Elevation	Length of Screen	Strata Monitored
MW-3S	Production	5/88	4"	248937.06	524119.09	14.57	16.61	20.00	-5.43	18.00	-3.43	8.00	6.57	10.00	UD/Fill
MW-4S	Production	5/88	4"	249005.42	523860.29	18.40	21.29	19.00	-0.60	16.00	2.40	6.00	12.40	10.00	UD/Fill
MW-7S	W. Water	5/88	4"	249307.92	525182.07	13.00	15.25	NA	NA	18.00	-5.00	8.00	5.00	10.00	NE
MW-8S	W. Water	5/88	4"	249217.26	524936.35	15.13	17.57	30.00	-14.87	15.50	-0.37	5.50	9.63	10.00	UD/Fill
MW-9S	W. Water	5/88	4"	249576.85	524963.95	15.50	17.91	34.00	-18.50	13.00	2.50	3.00	12.50	10.00	UD/Fill
MW-6S	Warwick	5/88	4"	248995.70	525283.37	11.91	14.04	30.00	-18.09	13.50	-1.59	3.50	8.41	10.00	UD
MW-5S	Production	5/88	4"	249788.80	523849.90	23.82	26.17	18.00	5.82	16.00	7.82	6.00	17.82	10.00	UD
PHASE IA REPORT															
P-19D	W. Water	7/90	1-1/4"	249349.16	525315.77	13.70	17.21	28.10	-14.40	28.10	-14.40	25.10	-11.40	3.00	UD
P-18D	Warwick	7/90	1-1/4"	248993.61	525312.07	11.41	13.27	NA	NA	66.00	-54.59	63.00	-51.59	3.00	UD
P-15S	Warwick	7/90	1-1/4"	248665.87	524090.11	13.95	15.69	NA	NA	15.50	-1.55	12.50	1.45	3.00	UD
P-16S	Warwick	7/90	1-1/4"	248392.01	524030.95	14.26	16.29	NA	NA	15.50	-1.24	12.50	1.76	3.00	UD
P-17S	Warwick	7/90	1-1/4"	248521.88	524237.36	15.28	17.07	NA	NA	14.50	0.78	11.50	3.78	3.00	UD
P-21S	Warwick	7/90	1-1/4"	248901.93	524435.27	15.19	16.96	NA	NA	17.00	-1.81	14.00	1.19	3.00	UD
P-21D	Warwick	7/90	1-1/4"	248907.61	524443.58	14.04	15.75	42.00	-27.96	37.00	-22.96	34.00	-19.96	3.00	UD
P-22S	Warwick	7/90	1-1/4"	248494.29	524718.20	16.53	18.75	NA	NA	15.50	1.03	12.50	4.03	3.00	UD
P-22D	Warwick	7/90	1-1/4"	248485.76	524729.56	16.60	17.57	58.50	-41.90	58.00	-41.40	55.00	-38.40	3.00	UD
P-20S	Off-Site	7/90	1-1/4"	249046.23	524252.46	24.60	24.02	NA	NA	22.00	2.60	19.00	5.60	3.00	UD
P-20D	Off-Site	7/90	1-1/4"	249044.49	524256.97	24.61	24.30	NA	NA	26.00	-1.39	23.00	1.61	3.00	UD
RW-1	Production	8/90	4"	248864.87	523989.83	14.94	16.52	59.70	-44.76	91.00	-76.06	81.00	-66.06	10.00	BR
RW-2	W. Water	8/90	4"	249219.69	524915.59	14.87	18.05	50.00	-35.13	70.00	-55.13	60.00	-45.13	10.00	BR
RW-3	Warwick	8/90	4"	248990.60	525291.75	11.87	13.49	60.00	-48.13	82.00	-70.13	72.00	-60.13	10.00	BR
RW-4	Off-Site	8/90	4"	249039.74	524255.17	24.08	23.79	33.50	9.42	50.00	-25.92	40.00	-15.92	10.00	BR
PHASE IB (INTERIM REPORT)															
MW-12S	Production	11/90	4"	249087.90	523928.71	19.80	22.54	NA	NA	16.00	3.80	6.00	13.80	10.00	UD
MW-12D	Production	11/90	4"	249081.89	523930.27	19.80	21.23	48.00	-28.20	43.50	-23.70	33.50	-13.70	10.00	UD
MW-13S	Production	11/90	4"	248966.55	524005.73	16.00	18.44	17.00	-1.00	14.75	1.25	4.75	12.25	10.00	UD
MW-15S	W. Water	11/90	4"	249406.35	525019.27	14.70	16.65	NA	NA	16.00	-1.30	6.00	9.30	10.00	UD
MW-15D	W. Water	11/90	4"	249403.41	525025.82	14.90	16.99	48.50	-33.60	43.00	-28.10	33.00	-18.10	10.00	UD
MW-11S	Warwick	11/90	4"	249030.13	525295.39	11.60	13.67	16.00	-4.40	13.00	-1.40	3.00	9.40	10.00	UD

S: 87x4660\rfirpt\tables\CONSTR.XLS
7/28/95 9:43 PM

Table 2-3
Piezometer and Well Location and Construction Details

Well/ Piezometer Number	Area	Month/ Year of Installation	Radius of Riser	Location Data		Elevation Data		Monitoring Well/Piezometer Data							
								Boring Data		Bottom of Monitoring Zone		Top of Monitoring Zone			
				Northing	Easting	Ground Surface	Top of Riser Pipe	Depth	Bottom Elevation	Depth	Elevation	Depth	Elevation	Length of Screen	Strata Monitored
MW-16S	Production	11/90	4"	249664.36	523928.62	24.10	26.00	NA	NA	18.08	6.02	8.08	16.02	10.00	UD
MW-16D	Production	11/90	4"	249661.68	523925.51	24.30	26.44	48.00	-23.70	38.17	-13.87	28.17	-3.87	10.00	UD
MW-17S	Warwick	11/90	4"	246619.28	524630.57	15.60	16.75	NA	NA	13.67	1.93	3.67	11.93	10.00	UD
MW-17D	Warwick	11/90	4"	248612.22	524625.72	15.30	17.29	89.00	-73.70	85.08	-69.78	75.08	-59.78	10.00	UD
MW-18S	Off-Site	11/90	4"	249812.29	524916.42	35.70	35.28	NA	NA	25.00	10.70	15.00	20.70	10.00	UD
MW-19S	Off-Site	11/90	4"	249177.41	524468.03	29.70	29.17	NA	NA	20.67	9.03	10.67	19.03	10.00	UD
MW-10S	Production	12/90	4"	249130.69	523867.42	20.30	22.62	NA	NA	18.00	2.30	8.00	12.30	10.00	UD
MW-10D	Production	12/90	4"	249131.66	523871.25	20.30	21.61	48.00	-25.70	43.50	-23.20	33.50	-13.20	10.00	UD
MW-14S	Production	12/90	4"	248988.21	523777.71	18.90	21.39	19.50	-0.60	16.17	2.73	6.17	12.73	10.00	UD
P-25D	W. Water	12/90	1-1/4"	249367.92	524768.73	14.20	16.93	71.50	-57.30	66.00	-51.80	63.00	-48.80	3.00	UD
P-26S	Warwick	12/90	1-1/4"	248442.06	524263.05	15.30	17.29	NA	NA	14.50	0.80	11.50	3.80	3.00	UD
P-26D	Warwick	12/90	1-1/4"	248444.97	524267.10	15.20	17.59	56.00	-40.80	41.00	-25.80	38.00	-22.80	3.00	UD
P-27D	Warwick	12/90	1-1/4"	248659.16	524088.49	14.00	15.76	52.50	-38.50	43.00	-29.00	40.00	-26.00	3.00	UD
P-23D	Off-Site	12/90	1-1/4"	249814.28	524920:26	35.70	35.42	90.50	-54.80	87.00	-51.30	84.00	-48.30	3.00	UD
P-24D	Off-Site	12/90	1-1/4"	249182.03	524467.11	29.80	29.43	44.17	-14.37	39.00	-9.20	36.00	-6.20	3.00	UD
STABILIZATION INVESTIGATION															
P-2D	Production	6/92	1-1/4"	248705.76	523891.36	12.96	16.00	52.00	-39.04	49.00	-36.04	46.00	-33.04	3.00	UD
P-13D	Production	6/92	1-1/4"	248963.34	523999.55	15.67	18.85	40.00	-24.33	38.00	-22.33	35.00	-19.33	3.00	UD
P-30D	Production	6/92	1-1/4"	248832.56	524015.55	(c)	16.43	48.24	-31.81	47.24	-30.81	44.24	-27.81	3.00	UD
P-32S	Production	6/92	1-1/4"	248894.28	524019.10	13.98	17.02	NA	NA	14.00	-0.02	11.00	2.98	3.00	UD
P-32D	Production	6/92	1-1/4"	248888.63	524022.99	13.91	17.10	41.50	-27.59	39.00	-25.09	36.00	-22.09	3.00	UD
P-33S	Production	6/92	1-1/4"	248773.13	523913.84	14.35	17.74	NA	NA	15.00	-0.65	12.00	2.35	3.00	UD
P-33D	Production	6/92	1-1/4"	248771.80	523919.57	13.93	16.99	56.00	-42.07	51.00	-37.07	48.00	-34.07	3.00	UD
MW-20S	Production	6/92	4"	249135.33	523746.39	18.83	21.94	19.00	-0.17	16.00	2.83	6.00	12.83	10.00	UD
MW-21S	Production	6/92	4"	248833.96	523754.94	15.82	15.42	19.00	-3.18	16.00	-0.18	6.00	9.82	10.00	UD
MW-22S	Production	6/92	4"	248691.83	523774.24	13.94	16.87	18.00	-4.06	15.00	-1.06	5.00	8.94	10.00	UD
MW-23S	Production	6/92	4"	249000.25	524116.10	21.10	20.71	23.00	-1.90	20.00	1.10	10.00	11.10	10.00	UD
MW-24S	Production	6/92	4"	249119.76	523973.00	21.59	21.04	21.00	0.59	18.00	3.59	8.00	13.59	10.00	UD
MW-29S	Production	6/92	2"	248856.36	524044.90	(c)	16.66	NA	NA	32.60	-15.94	27.60	-10.94	5.00	UD
MW-29D	Production	6/92	2"	248853.29	524047.94	(c)	16.59	NA	NA	44.00	-27.41	34.00	-17.41	10.00	UD
MW-30S	Production	6/92	2"	248829.79	524018.83	(c)	16.70	NA	NA	35.00	-18.30	30.00	-13.30	5.00	UD

Table 2-3
Piezometer and Well Location and Construction Details

Well/ Piezometer Number	Area	Month/ Year of Installation	Radius of Riser	Location Data		Elevation Data		Monitoring Well/Piezometer Data							
								Boring Data		Bottom of Monitoring Zone		Top of Monitoring Zone			
				Northing	Easting	Ground Surface	Top of Riser Pipe	Depth	Bottom Elevation	Depth	Elevation	Depth	Elevation	Length of Screen	Strata Monitored
MW-30D	Production	6/92	2"	248827.11	524022.12	(c)	16.67	NA	NA	46.00	-29.33	36.00	-19.33	10.00	UD
RC-1	Production	6/92	6"	248901.46	524014.25	14.48	16.33	43 (g)	NA	38.00	-23.52	8.00	6.48	30.00	UD
RC-2	Production	6/92	6"	248776.43	523907.29	14.57	16.85	53 (g)	NA	51.00	-36.43	23.00	-8.43	28.00	UD
MW-5SA	Production	6/92	3"	249790.17	523856.74	23.75	26.85	NA	NA	16.00	7.75	6.00	17.75	10.00	NE
MW-31S	Production	7/92	2"	248733.93	523948.45	(c)	16.27	NA	NA	25.50	-9.23	20.50	-4.23	5.00	UD
MW-31D	Production	7/92	2"	248731.30	523952.59	(c)	16.21	NA	NA	46.00	-29.79	36.00	-19.79	10.00	UD
P-29D	Production	7/92	1-1/4"	248859.48	524041.69	(c)	16.51	43.82	-27.31	41.82	-25.31	38.82	-22.31	3.00	UD
P-31D	Production	7/92	1-1/4"	248736.09	523945.12	(c)	16.45	55.00	-38.55	52.70	-36.25	49.70	-33.25	3.00	UD
VE-1	Production	7/92	2"	249017.03	523805.75	19.36	21.80	NA	NA	19.50	-0.14	4.50	14.86	15.00	NE
VE-2	Production	7/92	4"	248997.04	523810.46	19.20	21.59	NA	NA	19.50	-0.30	4.50	14.70	15.00	NE
VE-3	Production	7/92	2"	248969.25	523817.54	18.75	21.14	NA	NA	-0.75	4.50	4.50	14.25	19.50	NE
P-34S	Production	11/92	2"	248794.77	523896.38	14.90	17.15	NA	NA	15.55	-0.65	10.55	4.35	5.00	NE
P-35S	Production	11/92	2"	248746.34	523937.41	13.10	15.32	NA	NA	14.98	-1.88	9.98	3.12	5.00	NE
P-36S	Production	11/92	2"	248800.73	523974.56	13.50	15.91	NA	NA	15.59	-2.09	10.59	2.91	5.00	NE
P-37S	Production	11/92	2"	248869.38	524032.30	13.60	15.69	NA	NA	14.71	-1.11	9.71	3.89	5.00	NE
P-38S	Production	11/92	2"	248913.77	524085.78	13.87	16.19	NA	NA	15.73	-1.83	10.73	3.17	5.00	NE
RC-3 *	Production	7/93	6"	248875.72	524022.10	14.00	15.72	42.00	-28.00	30.00	-16.00	15.00	-1.00	15.00	UD
RC-5 *	Production	7/93	6"	248715.22	523892.45	12.90	14.25	52.00	-39.10	40 (f)	-27.10	10.00	2.90	15.00	UD
VE-4 *	Production	7/93	4"	249027.43	523752.48	18.40	19.44	NA	NA	20.00	-1.60	5.00	13.40	15.00	NE
VE-5 *	Production	7/93	4"	248985.75	523754.07	18.70	19.62	NA	NA	20.00	-1.30	5.00	13.70	15.00	NE
VE-6 *	Production	7/93	4"	248940.42	523757.43	17.50	18.50	NA	NA	20.00	-2.50	5.00	12.50	15.00	NE
VE-7 *	Production	7/93	4"	248833.94	523760.95	15.80	16.97	NA	NA	20.00	-4.10	5.00	10.80	15.00	NE
VE-8 *	Production	7/93	4"	248924.72	523802.75	16.90	18.11	NA	NA	20.00	-3.10	5.00	11.90	15.00	NE
VE-9 *	Production	7/93	4"	248967.87	523790.53	18.60	19.60	NA	NA	20.00	-1.40	5.00	13.60	15.00	NE
VE-10 *	Production	7/93	4"	249002.68	523775.88	19.10	20.08	NA	NA	20.00	-0.90	5.00	14.10	15.00	NE
PHASE II INVESTIGATION															
MW-25S	W. Water	7/93	4"	249355.27	525044.36	14.80	16.93	17.00	-2.20	16.00	-1.20	6.00	8.80	10.00	UD
MW-11D	Warwick	7/93	4"	249026.32	525296.38	11.50	14.03	62.00	-50.50	58.00	-46.50	48.00	-36.50	10.00	UD
MW-26S	Warwick	7/93	4"	249117.57	525264.04	11.70	14.15	16.00	-4.30	14.00	-2.30	4.00	7.70	10.00	UD
MW-32S	Warwick	7/93	4"	248660.10	524620.01	15.30	17.78	16.00	-0.70	15.00	0.30	5.00	10.30	10.00	UD
MW-28S	Warwick	7/93	4"	248387.92	524971.47	14.70	17.27	16 (a)	-1.30	14.00	0.70	4.00	10.70	10.00	NE

S: 87x4660\rfirpt\tables\CONSTR.XLS
7/28/95 9:43 PM

Table 2-3
Piezometer and Well Location and Construction Details

Well/ Piezometer Number	Area	Month/ Year of Installation	Radius of Riser	Location Data		Elevation Data		Monitoring Well/Piezometer Data							
								Boring Data		Bottom of Monitoring Zone		Top of Monitoring Zone			
				Northing	Easting	Ground Surface	Top of Riser Pipe	Depth	Bottom Elevation	Depth	Elevation	Depth	Elevation	Length of Screen	Strata Monitored
MW-27S	Warwick	7/93	4"	248456.82	524639.45	15.50	17.81	18.00	-2.50	15.00	0.50	5.00	10.50	10.00	UD
MW-35S	Off-Site	7/93	4"	249733.64	523627.46	22.60	25.58	18.00	4.60	17.00	5.60	7.00	15.60	10.00	UD
MW-4D	Production	8/93	4"	249005.60	523867.27	18.20	20.52	54.00	-35.80	48.00	-29.80	38.00	-19.80	10.00	UD
MW-14D	Production	8/93	4"	248985.61	523772.30	18.90	21.36	50.00	-31.10	47.00	-28.10	37.00	-18.10	10.00	UD
MW-34D	Production	8/93	4"	248853.27	523848.14	16.60	19.02	56.00	-39.40	48.00	-31.40	38.00	-21.40	10.00	UD
MW-34S	Production	8/93	4"	248854.76	523842.93	16.40	18.85	NA (b)	NA	19.50	-0.65	9.50	9.35	10.00	UD

Notes:

Wells are grouped by reports in which their boring logs are provided.

* These wells were installed as part of the Stabilization Investigation. They have not been previously reported and will appear as part of this reprt.

NA Boring log not generated. See nested deep well for boring information.

1) Elevations and depths are reported in feet; elevations are referenced to Mean Sea Level.
2) — = Information Not Available
3) UD = Unconsolidated Deposits
4) BR = Bedrock
5) NE = Not Evaluated
6) Elevation data based on surveys by Waterman Engineering Co. of East Providence, RI, Louis Federici Associates of Providence, RI, and Woodward-Clyde Consultants of Wayne, NJ.

a) The boring log for MW-28S is unavailable.
b) MW-34S does not have boring log information - see MW-34D.
c) These piezometers and monitoring wells are constructed in the river and have no ground surface elevation.
d) MW-18S has a permanent cap over the collar.
e) MW-5S has been sealed and was replaced by MW-5SA.
f) RC-5 has 2 monitoring zones 1) 10-15 feet below ground surface, and; 2) 30-40 feet below ground surface.
g) RC-1 and RC-2 do not have boring logs - see P-32D and P-33D, respectively, for boring log information.
h) Total measured well depth, no boring information available.
i) Survey data not available, location is estimated on maps.

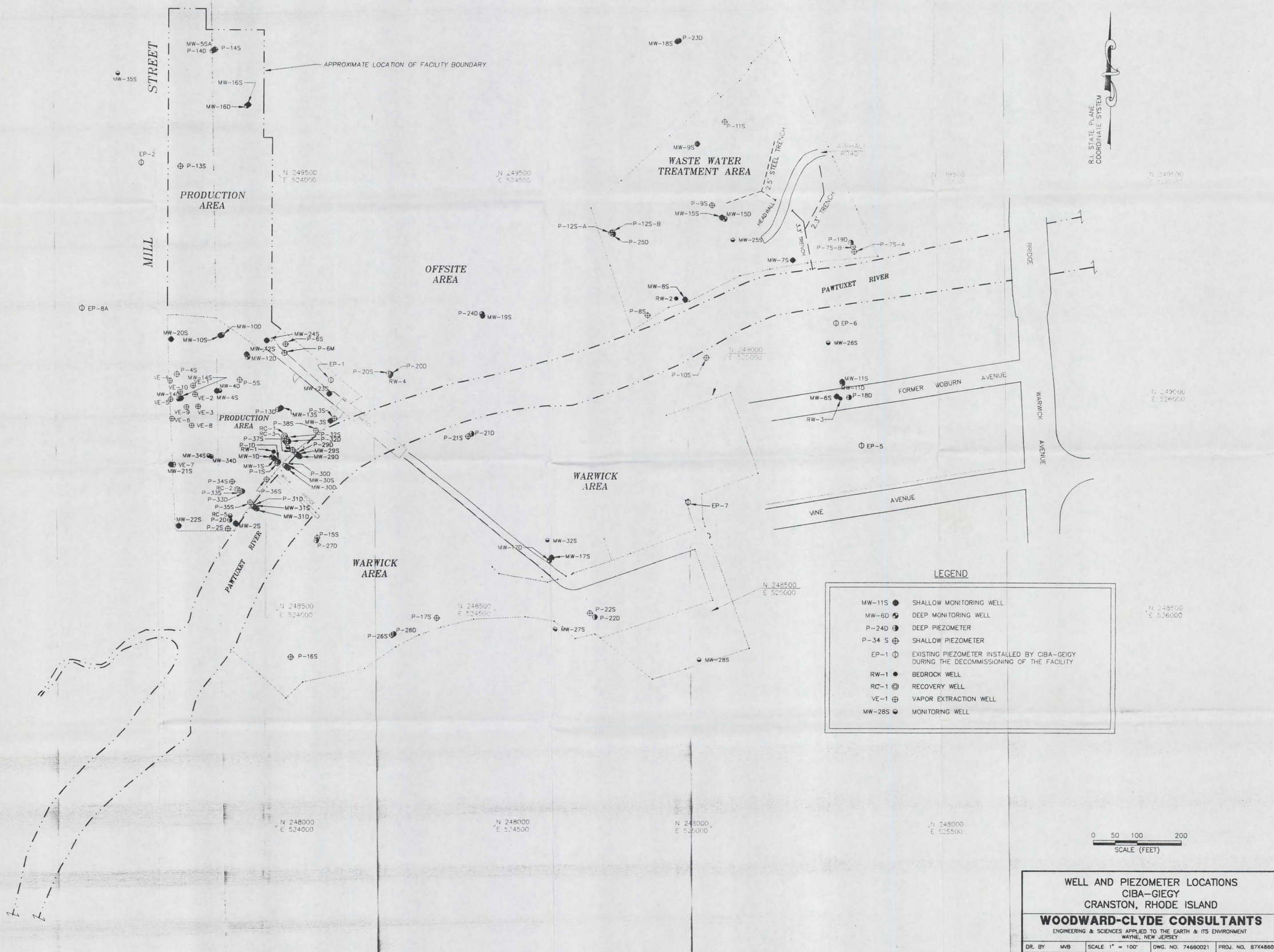
S: 87x4660\rfirpt\tables\CONSTR.XLS
7/28/95 9:43 PM

Table 2-4 Summary of Vertical Gradients

Shallow Well	Deep Well	Head Difference	Vertical Gradient	Head Difference	Vertical Gradient	Head Difference	Vertical Gradient	Head Difference	Vertical Gradient
Area / Date		4/29/93		7/29/93		10/29/93		1/31/94	
Production Area									
P-1S	P-1D	0.95	0.029	-0.58	-0.018	-0.74	-0.022	-0.52	-0.016
MW-2S	P-2D	-0.10	-0.003	-0.20	-0.006	-0.35	-0.010	-0.10	-0.003
P-14S	P-14D	0.33	0.009	0.25	0.007	0.17	0.005	0.35	0.009
MW-1S	MW-1D	-0.24	-0.007	-0.62	-0.018	2.70	0.079	0.47	0.014
MW-1D	RW-1	0.56	0.013	-0.35	-0.008	-0.27	-0.006	-0.36	-0.009
MW-4S	MW-4D	--	--	--	--	0.00	0.000	-0.69	-0.021
MW-10S	MW-10D	0.03	0.001	0.03	0.001	-0.15	-0.006	0.42	0.016
MW-12S	MW-12D	0.25	0.009	0.46	0.017	0.41	0.015	0.11	0.004
MW-14S	MW-14D	--	--	--	--	-0.04	-0.001	0.02	0.001
MW-16S	MW-16D	1.10	0.055	0.79	0.040	0.72	0.036	0.82	0.041
MW-29S	MW-29D	0.16	0.004	0.02	0.001	0.08	0.002	--	--
MW-30S	MW-30D	-0.06	-0.007	-0.05	-0.006	0.05	0.006	--	--
MW-31S	MW-31D	-0.07	-0.004	0.13	0.007	0.06	0.003	--	--
MW-34S	MW-34D	--	--	--	--	-0.69	-0.028	-0.22	-0.009
P-32S	P-32D	-0.44	-0.018	-0.56	-0.022	-0.70	-0.028	-0.56	-0.022
P-33S	P-33D	-0.82	-0.023	-0.37	-0.010	-0.91	-0.025	-0.65	-0.018
Warwick Area									
P-15S	P-27D	0.52	0.019	0.53	0.019	0.45	0.016	0.41	0.015
P-26S	P-26D	0.25	0.009	-0.25	-0.009	-0.50	-0.019	-0.73	-0.027
MW-17S	MW-17D	2.48	0.035	2.88	0.040	2.06	0.029	1.79	0.025
P-21S	P-21D	3.22	0.148	3.28	0.151	2.81	0.129	2.63	0.121
P-22S	P-22D	1.87	0.043	2.02	0.048	1.13	0.027	0.06	0.014
SWMU-5									
MW-6S	P-18D	4.46	0.079	3.93	0.070	3.50	0.062	--	--
P-18D	RW-3	-1.48	-0.123	0.09	0.007	-0.06	-0.005	--	--
MW-11S	MW-11D	--	--	--	--	3.32	0.074	3.14	0.070
Off-Site									
MW-19S	P-24D	-0.26	-0.012	0.06	0.003	-0.21	-0.010	-0.02	-0.001
P-20S	P-20D	0.61	0.153	0.03	0.008	-0.36	-0.090	-0.18	-0.045
P-20D	RW-4	-0.39	-0.019	0.19	0.009	0.12	0.006	0.24	0.011
Waste Water Treatment Area									
MW-15S	MW-15D	4.37	0.163	4.77	0.178	4.13	0.154	3.64	0.136

Notes: The head difference is the difference between the water level elevation of the deeper screened well minus that of the shallower well.
The vertical gradient is the head difference divided by the difference in elevation of the screen mid-points.

S: \87x4660\rfirpt\tables\VG.XLS



LEGEND

MW-11S ●	SHALLOW MONITORING WELL
MW-6D ◕	DEEP MONITORING WELL
P-24D ◑	DEEP PIEZOMETER
P-34 S ⊕	SHALLOW PIEZOMETER
EP-1 ⊖	EXISTING PIEZOMETER INSTALLED BY CIBA-GEIGY DURING THE DECOMMISSIONING OF THE FACILITY
RW-1 ●	BEDROCK WELL
RC-1 ◎	RECOVERY WELL
VE-1 ⊕	VAPOR EXTRACTION WELL
MW-28S ◒	MONITORING WELL

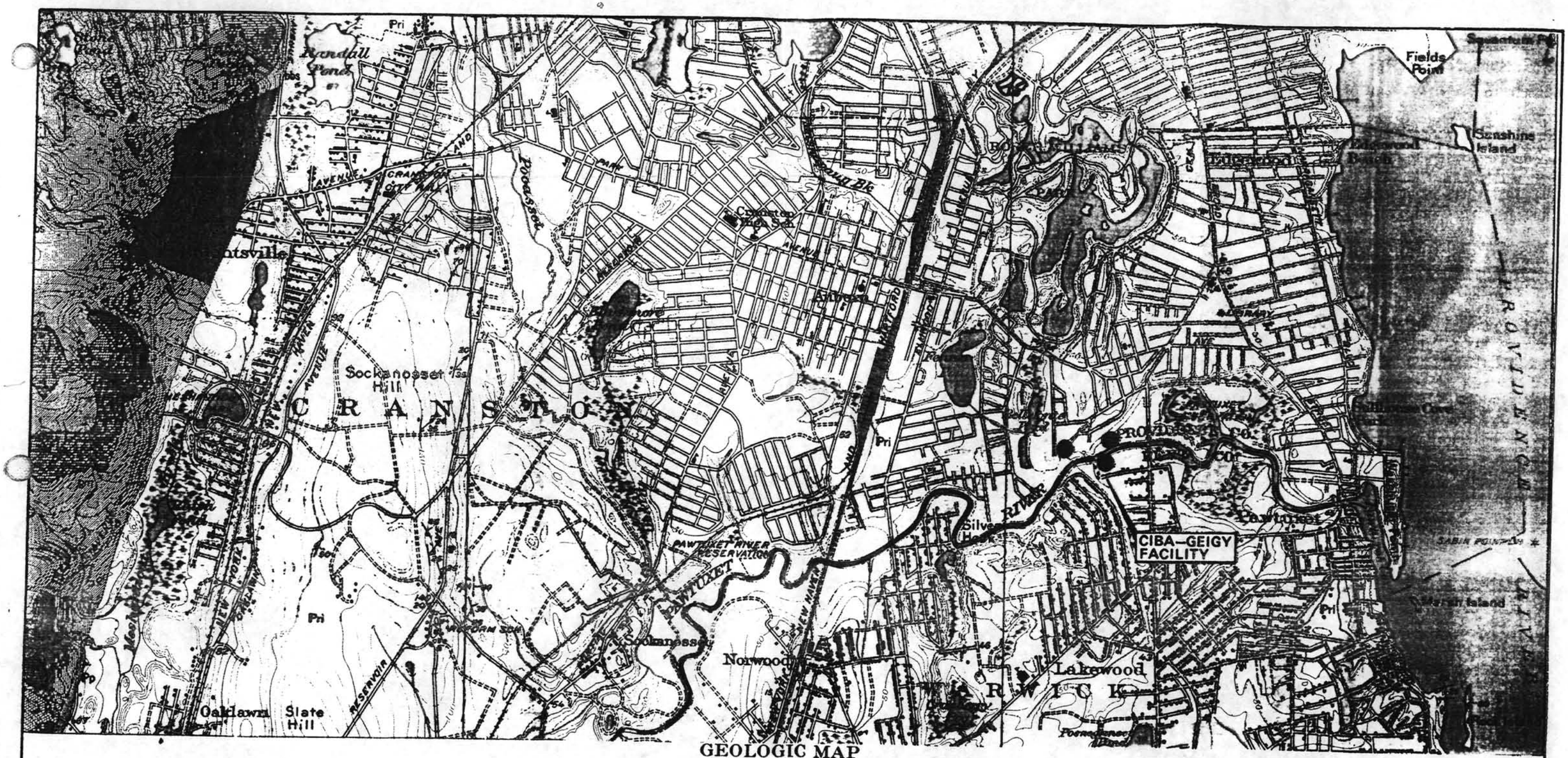
0 50 100 200
SCALE (FEET)

WELL AND PIEZOMETER LOCATIONS
CIBA-GIEGY
CRANSTON, RHODE ISLAND

WOODWARD-CLYDE CONSULTANTS
ENGINEERING & SCIENCES APPLIED TO THE EARTH & ITS ENVIRONMENT
WAYNE, NEW JERSEY

DR. BY MVB	SCALE 1" = 100'	DWG. NO. 74660021	PROJ. NO. 87X4860
CK'D. BY CLH	DATE JULY 27, 1995	FIG. NO. 2-1	

File name: K:\CADD\87X4860\74660021.DWG Last edited: 95/07/27 @ 07:12



GEOLOGIC MAP

OF THE

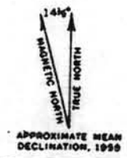
PROVIDENCE QUADRANGLE, RHODE ISLAND

BEDROCK GEOLOGY

By

Alonzo W. Quinn

1959



APPROXIMATE MEAN DECLINATION, 1959

Scale 1:24000

1 ½ 0 1 Mile

Contour interval 10 feet

Datum is mean sea level

REGIONAL BEDROCK GEOLOGY MAP
CIBA–GEIGY FACILITY
CRANSTON, RHODE ISLAND

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
WAYNE, NEW JERSEY

DR. BY:	KF	SCALE:	AS SHOWN	PROJ. NO.:	87X4660
CK'D. BY:	CJM	DATE:	15 FEB 1990	FIG. NO:	2–2

EXPLANATION

Sedimentary rocks of Narragansett basin — PENNSYLVANIAN

Pri — **Rhode Island formation**
Greenish, gray, dark-gray, to black graywacke, conglomerate, sandstone, shale, and meta-anthracite, as well as a few beds of red sandstone and shale at the northeast corner of the quadrangle; irregular bedding and crossbedding common; essentially unmetamorphosed in the north and changed to slate, phyllite, and schist in the south. May include Pondville conglomerate in covered areas

Pc — **Pondville conglomerate**
Gray, coarse-grained conglomerate, containing pebbles and cobbles of quartzite, schist, granite, and granite gneiss in a sandy or shaly matrix; beds irregular and discontinuous; pebbles elongate in southern half of quadrangle

Plutonic rocks — DEVONIAN(?) OR OLDER

eg — **Esmond granite**
Light-gray to light-pink, medium-grained massive

sg — **Scituate granite gneiss**
Light-gray to pink, medium- to coarse-grained; characterized by xploteky arrangement of biotite

gm — **Grant Mills granodiorite**
Gray to greenish-gray, porphyritic, massive to foliated and streaky

gn — **Granite gneiss**
Light-gray to dark-gray, fine- to medium-grained; in places containing numerous schist relicts in various stages of replacement

qd — **Quartz diorite**
Dull-gray to dark-gray, medium-grained and porphyritic, generally massive, but foliated where porphyritic; fine-grained and more foliated just east of Wenscott Reservoir

d — **Diorite**
Gray to dark-gray, medium- to coarse-grained, massive to schistose

Blackstone series — PRECAMBRIAN(?)

hg — **Hunting Hill greenstone**
Dark-green, fine-grained, massive to schistose; in part with clastic texture; veins and knots of epidote common

ha — **Metamorphosed porphyritic andesite**
Green, fine- to medium-grained, somewhat schistose; small patches of black biotite, knots and veinlets of epidote common; locally has a few pebbles; exposed only near north margin of quadrangle

b / bfs — **Sneech Pond schist**
Chiefly gray to greenish-gray, fine-grained, schistose, interbedded schist, greenstone, quartzite, and marble, b*; gray to light gray, medium- to coarse-grained, streaky feldspathic schist, with interbeds of quartzite; exposed northeast of Centerdale,* bfs

wq — **Westboro quartzite**
Bluish-gray to gray, medium-grained, massive to thin-bedded quartzite; with interbeds of greenish quartz-mica schist

bq / bbs — **Mussey Brook schist**
Chiefly green to greenish-gray, fine-grained, thin-bedded chlorite-quartz schist, but includes thin beds of hornblende schist, biotite schist, quartzite, marble, greenstone, steatite, and serpentine, bcs*; dark-gray to green, fine- to medium-grained amphibolite, schistose along margins, massive elsewhere,* ba*; gray to light-gray, medium- to fine-grained, thin-bedded to massive quartzite; includes beds of quartz-mica schist,* bq*; green to gray, fine-grained biotite-quartz schist, interbedded with quartz-mica schist, chlorite schist, amphibole schist, marble, and quartzite,* bbs

Bedrock outcrops and areas of closely spaced bedrock outcrops

Contact
Long dashes where approximately located; short dashes where indefinite; dotted where concealed

Fault, approximately located, showing strike and dip of fault plane
U, *upthrown side;* D, *downthrown side*

Strike and dip of bedding

Strike of vertical bedding

Strike and dip of foliation

Strike of vertical foliation

Direction and plunge of lineation

Direction and plunge of fold axes

Strike of vertical bedding and strike and dip of foliation

Strike and dip of parallel bedding and foliation

Strike and dip of parallel bedding and foliation; bearing and plunge of lineation

Strike of vertical bedding and foliation

Strike of vertical foliation; bearing and plunge of lineation

Strike and dip of foliation; bearing and plunge of fold axes

Strike and dip of bedding; bearing and plunge of fold axes

Structure symbols dashed where exposure is not now accessible

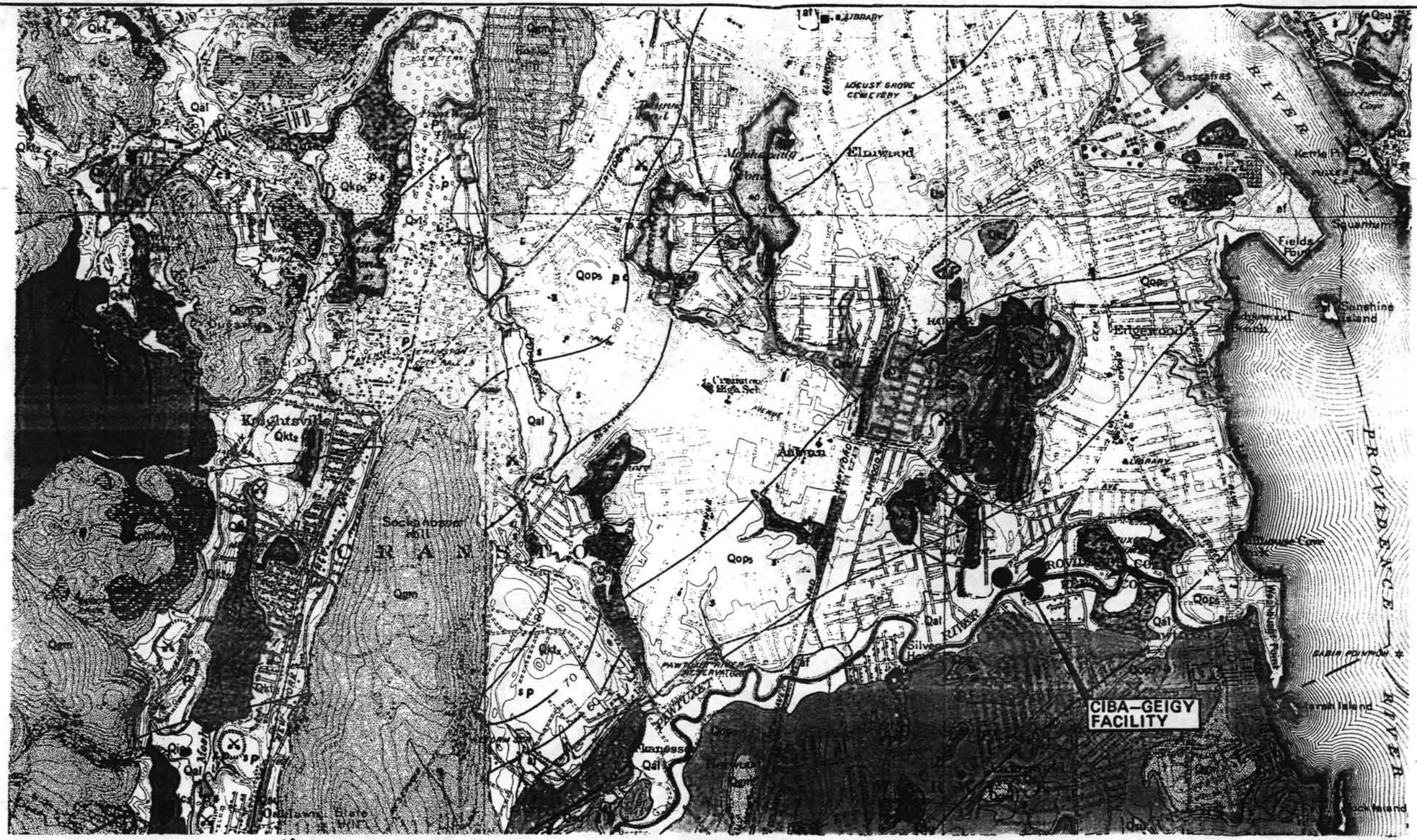
Quarry or mine

Small quarry, mine or prospect
Letter symbol indicates type of deposit; steatite, s*; marble,* m

LEGEND FOR FIGURE 2–2
CIBA–GEIGY FACILITY
CRANSTON, RHODE ISLAND

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
WAYNE, NEW JERSEY

DR. BY:	KF	SCALE:	AS SHOWN	PROJ. NO.:	87X4660
CK'D. BY:	CJM	DATE:	15 FEB 1990	FIG. NO:	2–2A



14½°
MAGNETIC NORTH
TRUE NORTH
APPROXIMATE MEAN DECLINATION, 1956

GEOLOGIC MAP
OF THE
PROVIDENCE QUADRANGLE, RHODE ISLAND
SURFICIAL GEOLOGY

By
J. Hiram Smith

Scale 1:31 680
1 ½ 0 1 Mile

Contour interval 10 feet
Datum is mean sea level

1956

REGIONAL SURFICIAL GEOLOGY MAP
CIBA–GEIGY FACILITY
CRANSTON, RHODE ISLAND

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
WAYNE, NEW JERSEY

DR. BY:	KF	SCALE:	AS SHOWN	PROJ. NO.:	87X4660
CK'D. BY:	CJM	DATE:	15 FEB 1990	FIG. NO:	2–3

EXPLANATION

Recent

Swamp deposits
Sand and Silt mixed with varying amounts of partly decomposed organic material; commonly with a thin surface layer of peaty material.

Qal

Flood-plain deposits
Chiefly medium to fine sand; in places interbedded gravel deposited by recent streams during flood stage.

River terraces
Medium to coarse sand and, in places, thin beds of gravel deposited as early alluvium. Terraces along the Seekonk River probably are erosional.

Qsu

Sand and gravel undifferentiated
Chiefly sand and, in places, small gravel lenses; in most places represent thin deposits formed in kettle holes; in other places represent small, local deposits formed during melting of ice block, or in temporary channels, which existed during the late stage of deglaciation.

Pleistocene

Qvfs

Qkps

Qops

Qkt$_x$

Qic$_x$

Valley train
Stratified sand and gravel deposited by glacial streams in the valley bottoms.

Kame plains
Flat-topped deposits of sand and gravel with ice-contact slopes on all sides.

Outwash plains
Sorted sand and local deposits of coarse gravel.

Kame terraces
Sand and gravel deposited by meltwater streams between ice in the valley and the valley wall.

Ice channel deposits
Ridges of sand and gravel; includes eskers and crevasse fillings.

Kames
Irregularly shaped mounds of sand and gravel.

Deposits graded to a local, temporary base level are shown by a single color. Order of deposition of each sequence shown by number subscripts of letter symbols; the letter "x" sub script indicates that the chronological order of deposition for that feature is not known.

Qgm

Ground moraine
Relatively thin layer of till with lenses of sorted material incorporated within the till; rest chiefly on bedrock.

QUATERNARY

PENNSYLVANIAN AND PRE-PENNSYLVANIAN

Bedrock outcrops
Solid color represents individual outcrops; ruled area represents group of closely spaced outcrops.

af

Artificial fill
Areas altered by artificial fill or excavation.

Contact
Solid line represents accurately located boundary; dashed line indicates gradational or approximate boundary.

Direction of ice movement as shown by grooves, striae, and friction cracks
Point of observation is point of arrow.

90

Interpreted contour
Drawn on restored integrated surface, dashed across those areas that are no longer part of the sequence.

Sand and gravel pit
Larger pits are hachured to show approximate boundaries.

s p c

Composition of deposits
Letter symbols indicate the composition of the deposit at that point; symbols arranged in order of relative abundance with most abundant material first: s, sand; p, pebble gravel; and c, cobble gravel.

Outflow channel
Outlet through which glacial meltwater stream flowed.

LEGEND FOR PROFILE 2–3
CIBA–GEIGY FACILITY
CRANSTON, RHODE ISLAND

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
WAYNE, NEW JERSEY

DR. BY:	KF	SCALE:	AS SHOWN	PROJ. NO.:	87X4660
CK'D. BY:	CJM	DATE:	15 FEB 1990	FIG. NO:	2–3A

LEGEND:

SOIL DELINEATIONS AND SYMBOLS — CeA / FoB2

MU MERRIMAC-URBAN LAND COMPLEX
Ru RUMNEY FINE SANDY LOAM
Ur URBAN LAND

0 1/4 1/2 MILE
SCALE

MAP SOURCE:
SOIL SURVEY OF RHODE ISLAND, USDA SOIL CONSERVATION SERVICE, 1981.

SOIL CONSERVATION MAP
CIBA – GEIGY FACILITY
CRANSTON, RHODE ISLAND

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
WAYNE, NEW JERSEY

DR. BY:	BAS	SCALE:	AS SHOWN	PROJ. NO.:	87X4660
CK'D. BY:	CLH	DATE:	6 MAR 1995	FIG. NO:	2–4

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

SOIL LEGEND

The first letter, always a capital, is the initial letter of the soil name. The second letter is a capital if the mapping unit is broadly defined; otherwise, it is a small letter. The third letter, always a capital, A, B, C, D, or E, indicates the slope. Most symbols without a slope letter are those of nearly level soils; however, some are for soils that have a considerable range of slope but have similar use interpretations.

SYMBOL	NAME
Aa	Adrian muck
AfA	Agawam fine sandy loam, 0 to 3 percent slopes
AfB	Agawam fine sandy loam, 3 to 8 percent slopes
Ba	Beaches
Bc	Birchwood sandy loam
BhA	Bridgehampton silt loam, 0 to 3 percent slopes
BhB	Bridgehampton silt loam, 3 to 8 percent slopes
BmA	Bridgehampton silt loam, till substratum, 0 to 3 percent slopes
BmB	Bridgehampton silt loam, till substratum, 3 to 8 percent slopes
BnB	Bridgehampton-Charlton complex, very stony, 0 to 8 percent slopes
BnC	Bridgehampton-Charlton complex, very stony, 8 to 15 percent slopes
BoC	Bridgehampton-Charlton complex, extremely stony, 3 to 15 percent slopes
BrA	Broadbrook silt loam, 0 to 3 percent slopes
BrB	Broadbrook silt loam, 3 to 8 percent slopes
BsB	Broadbrook very stony silt loam, 0 to 8 percent slopes
CaC	Canton-Charlton-Rock outcrop complex, 3 to 15 percent slopes
CaD	Canton-Charlton-Rock outcrop complex, 15 to 35 percent slopes
CB	Canton-Urban land complex
CC	Canton-Urban land complex, very rocky
CdA	Canton and Charlton fine sandy loams, 0 to 3 percent slopes
CdB	Canton and Charlton fine sandy loams, 3 to 8 percent slopes
CdC	Canton and Charlton fine sandy loams, 8 to 15 percent slopes
CeC	Canton and Charlton fine sandy loams, very rocky, 3 to 15 percent slopes
ChB	Canton and Charlton very stony fine sandy loams, 3 to 8 percent slopes
ChC	Canton and Charlton very stony fine sandy loams, 8 to 15 percent slopes
ChD	Canton and Charlton very stony fine sandy loams, 15 to 25 percent slopes
CkC	Canton and Charlton extremely stony fine sandy loams, 3 to 15 percent slopes
Co	Carlisle muck
Dc	Deerfield loamy fine sand
Du	Dumps
EfA	Enfield silt loam, 0 to 3 percent slopes
EfB	Enfield silt loam, 3 to 8 percent slopes
GBC	Gloucester-Bridgehampton complex, rolling
GBD	Gloucester-Bridgehampton complex, hilly
GhC	Gloucester-Hinckley very stony sandy loams, rolling
GhD	Gloucester-Hinckley very stony sandy loams, hilly
HkA	Hinckley gravelly sandy loam, 0 to 3 percent slopes
HkC	Hinckley gravelly sandy loam, rolling
HkD	Hinckley gravelly sandy loam, hilly
HnC	Hinckley-Enfield complex, rolling
Ip	Ipswich peat
LgC	Lippitt gravelly sandy loam, very rocky, 3 to 15 percent slopes
Ma	Mansfield mucky silt loam
Mc	Mansfield very stony mucky silt loam
Mk	Matunuck mucky peat
MmA	Merrimac sandy loam, 0 to 3 percent slopes
MmB	Merrimac sandy loam, 3 to 8 percent slopes
MU	Merrimac-Urban land complex
NaA	Narragansett silt loam, 0 to 3 percent slopes
NaB	Narragansett silt loam, 3 to 8 percent slopes
NbB	Narragansett very stony silt loam, 0 to 8 percent slopes
NbC	Narragansett very stony silt loam, 8 to 15 percent slopes
NcC	Narragansett extremely stony silt loam, 3 to 15 percent slopes
NeA	Newport silt loam, 0 to 3 percent slopes
NeB	Newport silt loam, 3 to 8 percent slopes
NeC	Newport silt loam, 8 to 15 percent slopes
NfB	Newport very stony silt loam, 3 to 8 percent slopes
NoC	Newport extremely stony silt loam, 3 to 15 percent slopes
NP	Newport-Urban land complex
Nt	Ninigret fine sandy loam
PaA	Paxton fine sandy loam, 0 to 3 percent slopes
PaB	Paxton fine sandy loam, 3 to 8 percent slopes
PbB	Paxton very stony fine sandy loam, 0 to 8 percent slopes
PbC	Paxton very stony fine sandy loam, 8 to 15 percent slopes
PcC	Paxton extremely stony fine sandy loam, 3 to 15 percent slopes
PD	Paxton-Urban land complex
Pg	Pits, gravel
Pk	Pits, quarries
PmA	Pittstown silt loam, 0 to 3 percent slopes
PmB	Pittstown silt loam, 3 to 8 percent slopes
PnB	Pittstown very stony silt loam, 0 to 8 percent slopes
Pp	Podunk fine sandy loam
PsA	Poquonock loamy fine sand, 0 to 3 percent slopes
PsB	Poquonock loamy fine sand, 3 to 8 percent slopes
QoA	Quonset gravelly sandy loam, 0 to 3 percent slopes
QoC	Quonset gravelly sandy loam, rolling
RaA	Rainbow silt loam, 0 to 3 percent slopes
RaB	Rainbow silt loam, 3 to 8 percent slopes
RbB	Rainbow very stony silt loam, 0 to 8 percent slopes
Rc	Raypol silt loam
Re	Ridgebury fine sandy loam
Rf	Ridgebury, Whitman, and Leicester extremely stony fine sandy loams
Rk	Rock outcrop
Rp	Rock outcrop-Canton complex
Ru	Rumney fine sandy loam
Sb	Scarboro mucky sandy loam
ScA	Scio silt loam, 0 to 3 percent slopes
SdB	Scio very stony silt loam, 0 to 8 percent slopes
Se	Stissing silt loam
Sf	Stissing very stony silt loam
Ss	Sudbury sandy loam
StA	Sutton fine sandy loam, 0 to 3 percent slopes
StB	Sutton fine sandy loam, 3 to 8 percent slopes
SuB	Sutton very stony fine sandy loam, 0 to 8 percent slopes
SvB	Sutton extremely stony fine sandy loam, 0 to 8 percent slopes
Tb	Tisbury silt loam
UAB	Udipsamments, undulating
UBE	Udorthents, very steep
UD	Udorthents-Urban land complex
Ur	Urban land
Wa	Walpole sandy loam
WbA	Wapping silt loam, 0 to 3 percent slopes
WbB	Wapping silt loam, 3 to 8 percent slopes
WcB	Wapping very stony silt loam, 0 to 8 percent slopes
WdB	Wapping extremely stony silt loam, 0 to 8 percent slopes
WgA	Windsor loamy sand, 0 to 3 percent slopes
WgB	Windsor loamy sand, 3 to 8 percent slopes
WhA	Woodbridge fine sandy loam, 0 to 3 percent slopes
WhB	Woodbridge fine sandy loam, 3 to 8 percent slopes
WoB	Woodbridge very stony fine sandy loam, 0 to 8 percent slopes
WrB	Woodbridge extremely stony fine sandy loam, 0 to 8 percent slopes
W	Water

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline
- AD HOC BOUNDARY (label)
- Small airport, airfield, park, oil field, cemetery, or flood pool (Davis Airstrip; FLOOD POOL LINE)
- STATE COORDINATE TICK
- LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate (79)
- Federal (410)
- State (52)
- County, farm or ranch (378)
- RAILROAD
- POWER TRANSMISSION LINE (normally not shown)
- PIPELINE (normally not shown)
- FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small (water)

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (GAS)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
- Double-line (label) (CANAL)
- Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water)
- Intermittent (int)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well irrigation
- Wet spot

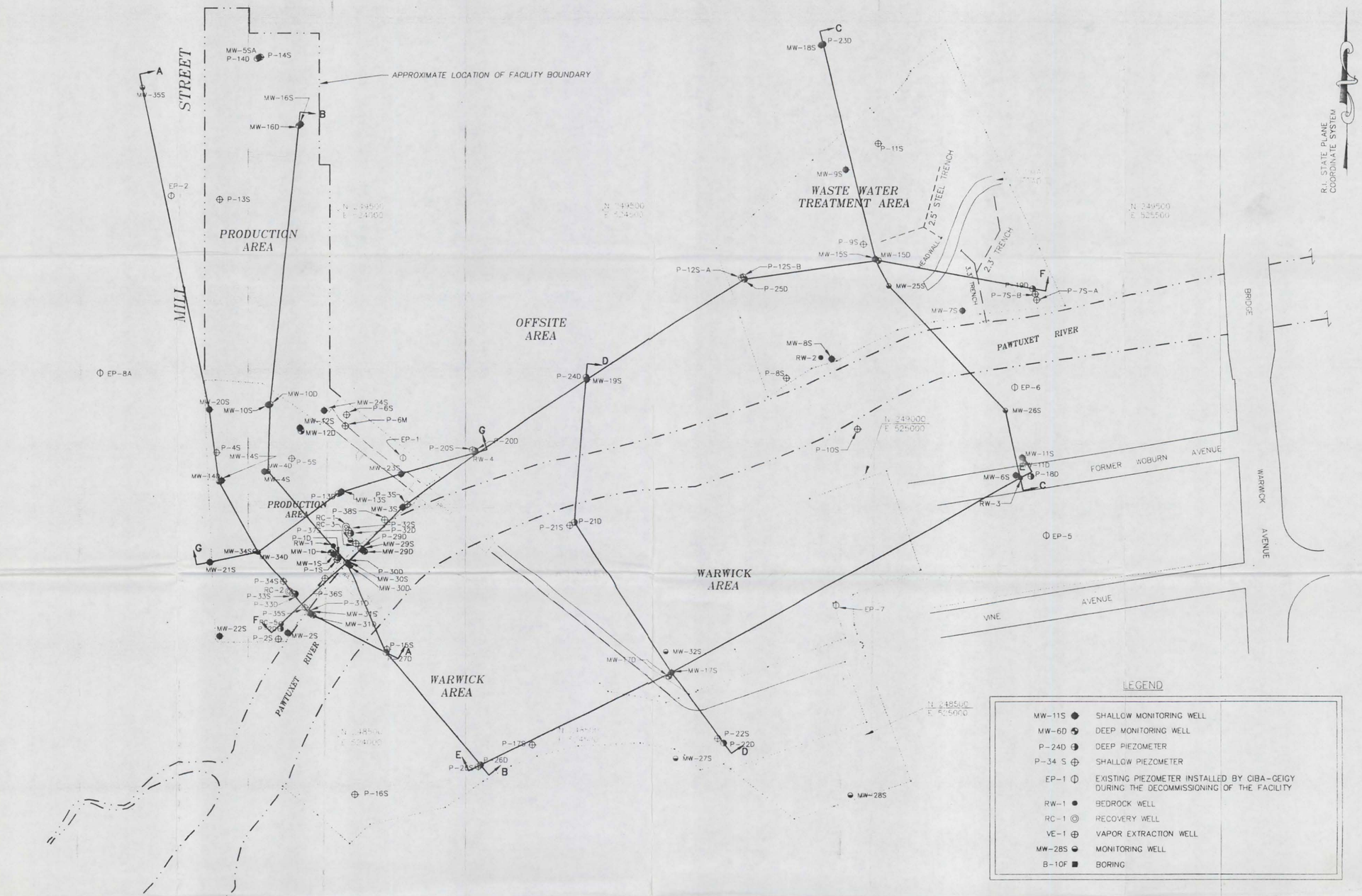
SPECIAL SYMBOLS FOR SOIL SURVEY

- SOIL DELINEATIONS AND SYMBOLS (CeA, FoB2)
- ESCARPMENTS
  - Bedrock (points down slope)
  - Other than bedrock (points down slope)
- SHORT STEEP SLOPE
- GULLY
- DEPRESSION OR SINK
- SOIL SAMPLE SITE (normally not shown) (S)
- MISCELLANEOUS
  - Blowout
  - Clay spot
  - Gravelly spot
  - Gumbo, slick or scabby spot (sodic)
  - Dumps and other similar non soil areas
  - Prominent hill or peak
  - Rock outcrop (includes sandstone and shale)
  - Saline spot
  - Sandy Spot
  - Severely eroded spot
  - Slide or slip (tips point upslope)
  - Stony spot, very stony spot
  - Bunker

LEGEND FOR FIGURE 2–4
CIBA – GEIGY FACILITY
CRANSTON, RHODE ISLAND

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
WAYNE, NEW JERSEY

DR. BY:	BAS	SCALE:	NONE	PROJ. NO.:	87X4660
CK'D. BY:	CLH	DATE:	6 MAR 1995	FIG. NO:	2–4A



LEGEND

MW-11S ●	SHALLOW MONITORING WELL
MW-6D ◔	DEEP MONITORING WELL
P-24D ◑	DEEP PIEZOMETER
P-34 S ⊕	SHALLOW PIEZOMETER
EP-1 ⓘ	EXISTING PIEZOMETER INSTALLED BY CIBA-GEIGY DURING THE DECOMMISSIONING OF THE FACILITY
RW-1 ●	BEDROCK WELL
RC-1 ◎	RECOVERY WELL
VE-1 ⊕	VAPOR EXTRACTION WELL
MW-28S ◒	MONITORING WELL
B-10F ■	BORING

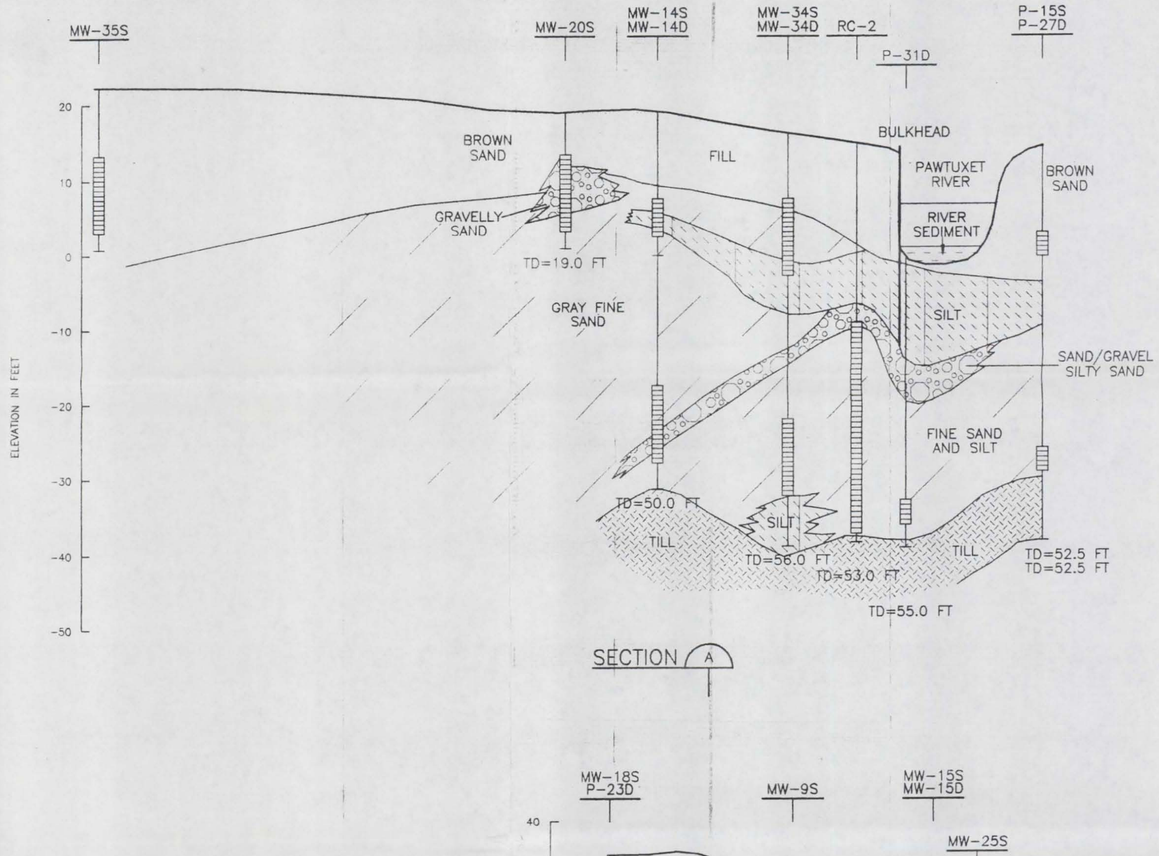
0 50 100 200
SCALE (FEET)

CROSS-SECTION LOCATION MAP
CIBA-GIEGY
CRANSTON, RHODE ISLAND

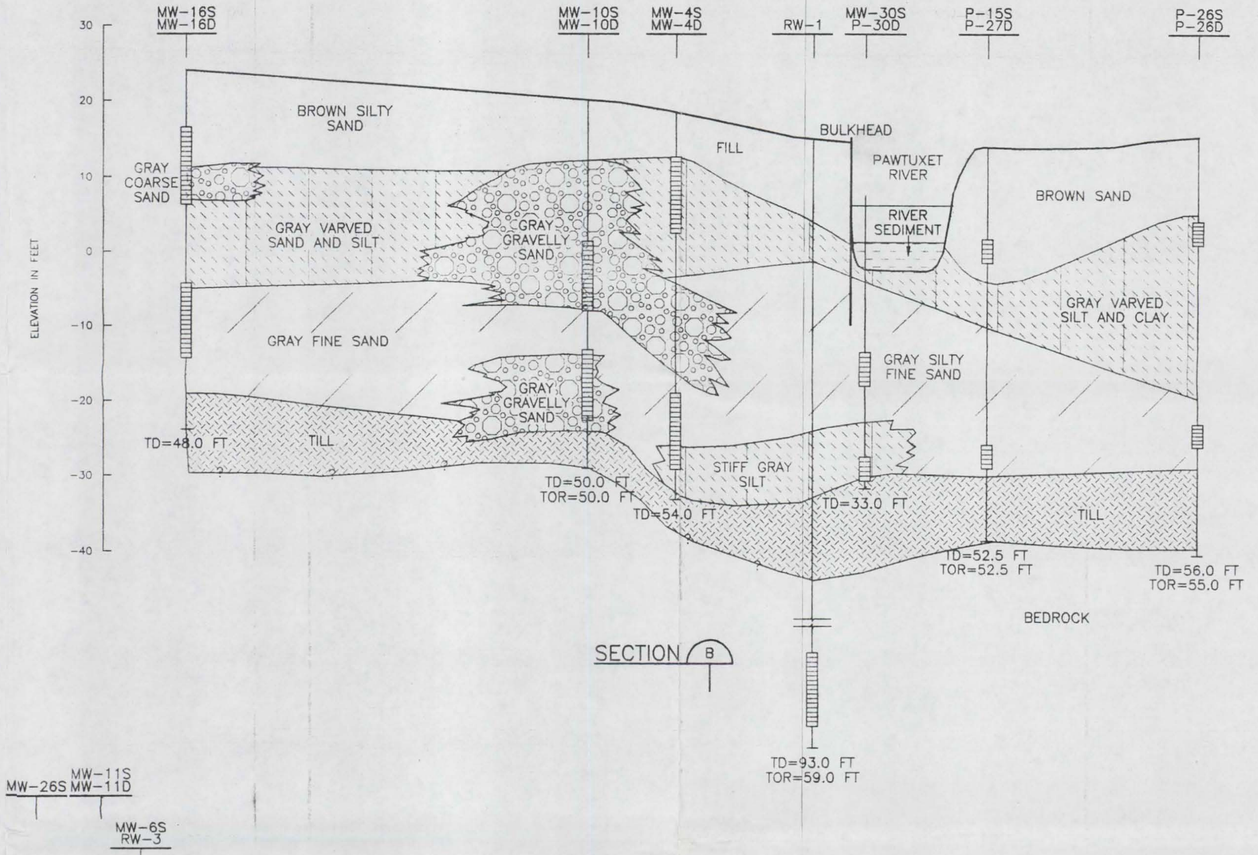
WOODWARD-CLYDE CONSULTANTS
ENGINEERING & SCIENCES APPLIED TO THE EARTH & ITS ENVIRONMENT
WAYNE, NEW JERSEY

DR. BY	MVB	SCALE 1" = 100'	DWG. NO. 74660023	PROJ. NO.	87X4660
CK'D. BY	CLH	DATE APR 13, 1995	FIG. NO.	2-5	

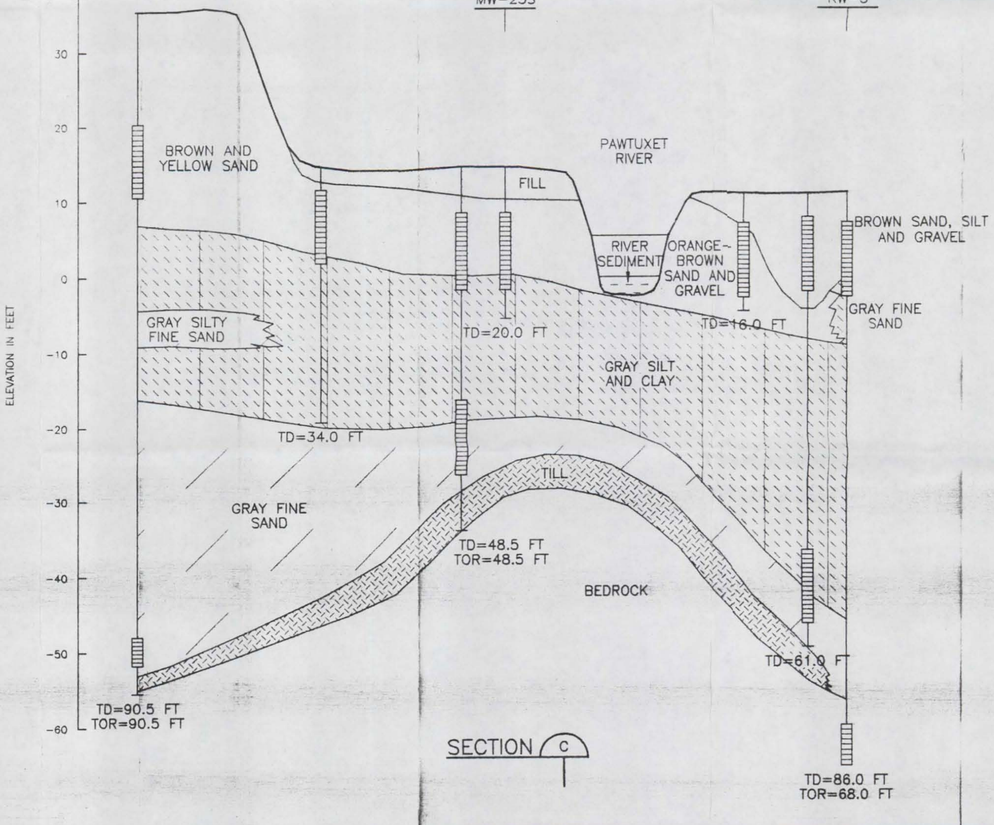
File name: K:\CADD\87X4660\74660023.DWG Last edited: 95/04/13 @ 14:60



SECTION A



SECTION B



SECTION C

LEGEND

P-23D	WELL NUMBER
	APPROXIMATE GROUND SURFACE
	APPROXIMATE LOCATION OF STRATIGRAPHIC BOUNDARY
	SCREEN INTERVAL
TD	TOTAL DEPTH
TOR	TOP OF ROCK

0 5 10 20
VERTICAL SCALE (FEET)

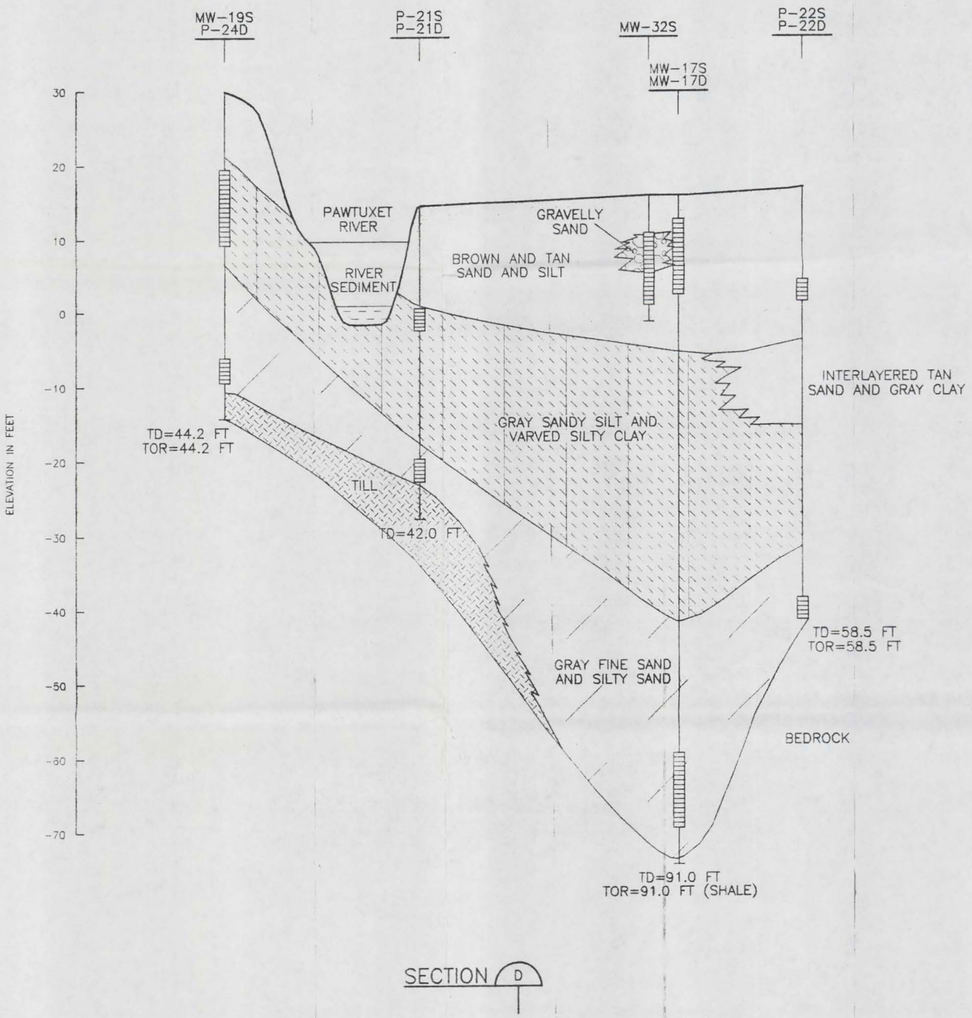
0 50 100 200
HORIZONTAL SCALE (FEET)

CROSS-SECTIONS A, B AND C
CIBA-GEIGY
CRANSTON, RHODE ISLAND

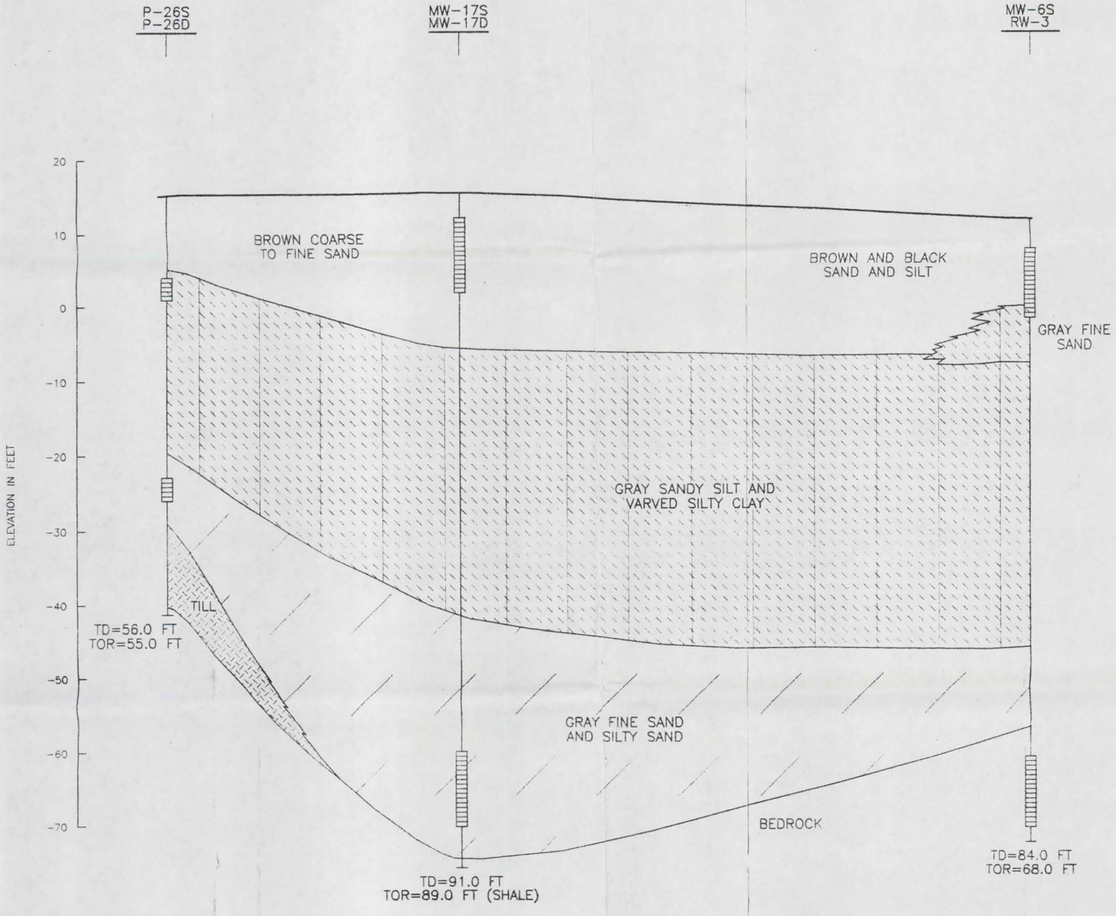
WOODWARD-CLYDE CONSULTANTS
ENGINEERING & SCIENCES APPLIED TO THE EARTH & ITS ENVIRONMENT
WAYNE, NEW JERSEY

DR. BY MVB	SCALE AS SHOWN	DWG. NO. 74660024	PROJ. NO. 87X4660
CK'D. BY CLH	DATE APR 13, 1995	FIG. NO. 2-6	

File name: N:\CADD\87X4660\74660024.DWG Last edited: 95/04/13 @ 15:25



SECTION D



SECTION E

LEGEND

- P-21D — WELL NUMBER
- APPROXIMATE GROUND SURFACE
- APPROXIMATE LOCATION OF STRATIGRAPHIC BOUNDARY
- SCREEN INTERVAL
- TD — TOTAL DEPTH
- TOR — TOP OF ROCK

0 5 10 20
VERTICAL SCALE (FEET)

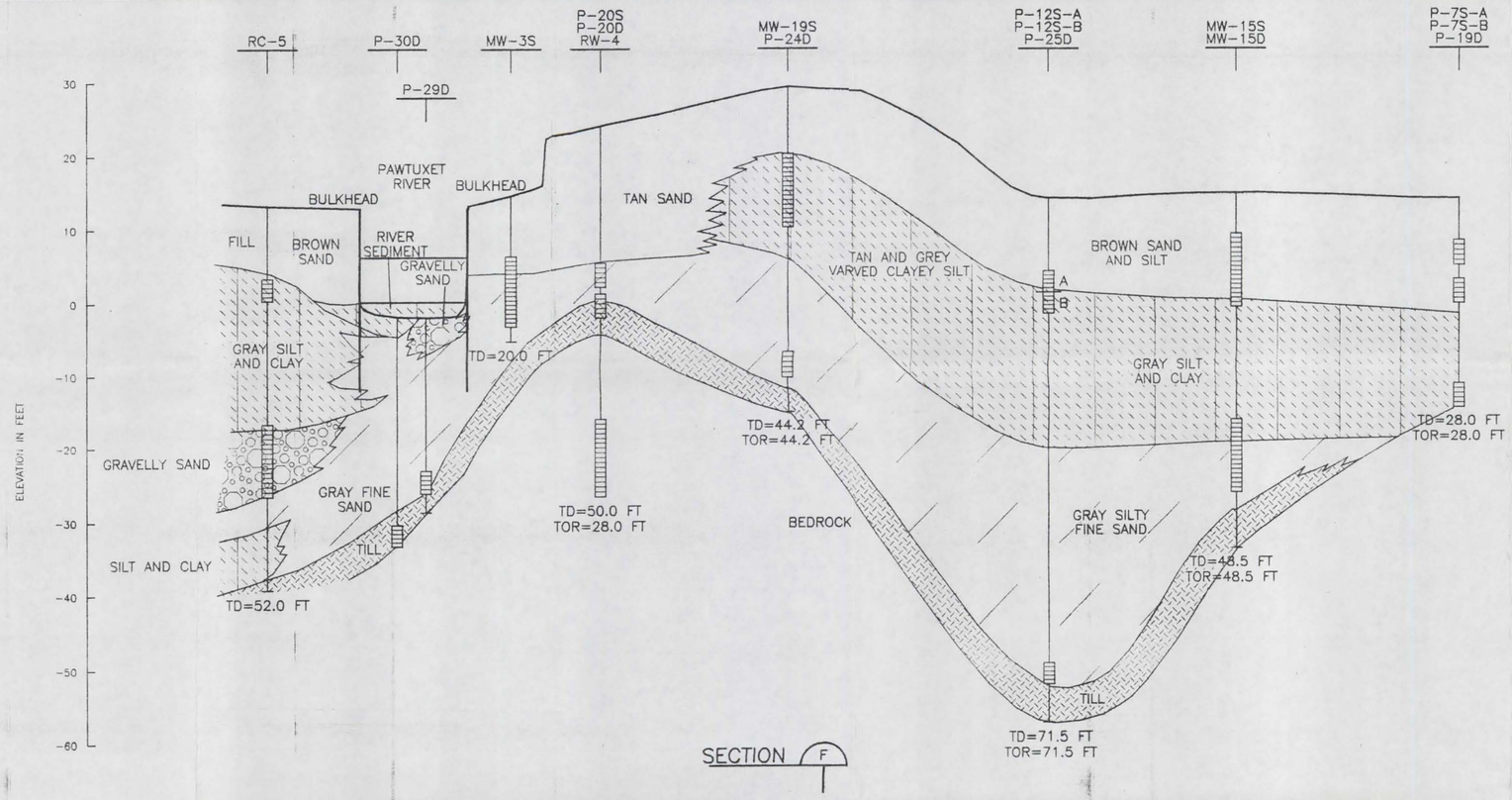
0 50 100 200
HORIZONTAL SCALE (FEET)

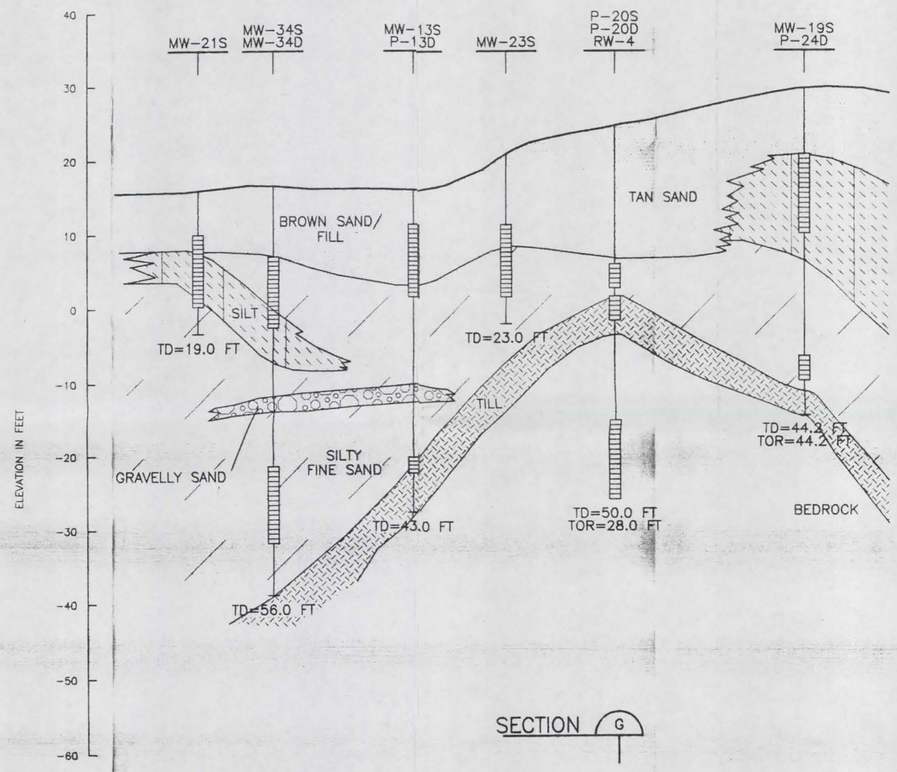
CROSS-SECTIONS D AND E
CIBA-GEIGY
CRANSTON, RHODE ISLAND

WOODWARD-CLYDE CONSULTANTS
ENGINEERING & SCIENCES APPLIED TO THE EARTH & ITS ENVIRONMENT
WAYNE, NEW JERSEY

DR. BY	MVB	SCALE AS SHOWN	DWG. NO. 74660025	PROJ. NO. 87X4660
CK'D. BY	CLH	DATE MAR 7, 1995	FIG. NO.	2-7

File name: K:\CADD\87X4660\74660025.DWG Last edited: 95/03/07 @ 13:52





LEGEND

P-24D	WELL NUMBER
	APPROXIMATE GROUND SURFACE
	APPROXIMATE LOCATION OF STRATIGRAPHIC BOUNDARY
	SCREEN INTERVAL
TD TOR	TOTAL DEPTH TOP OF ROCK

0 5 10 20
VERTICAL SCALE (FEET)

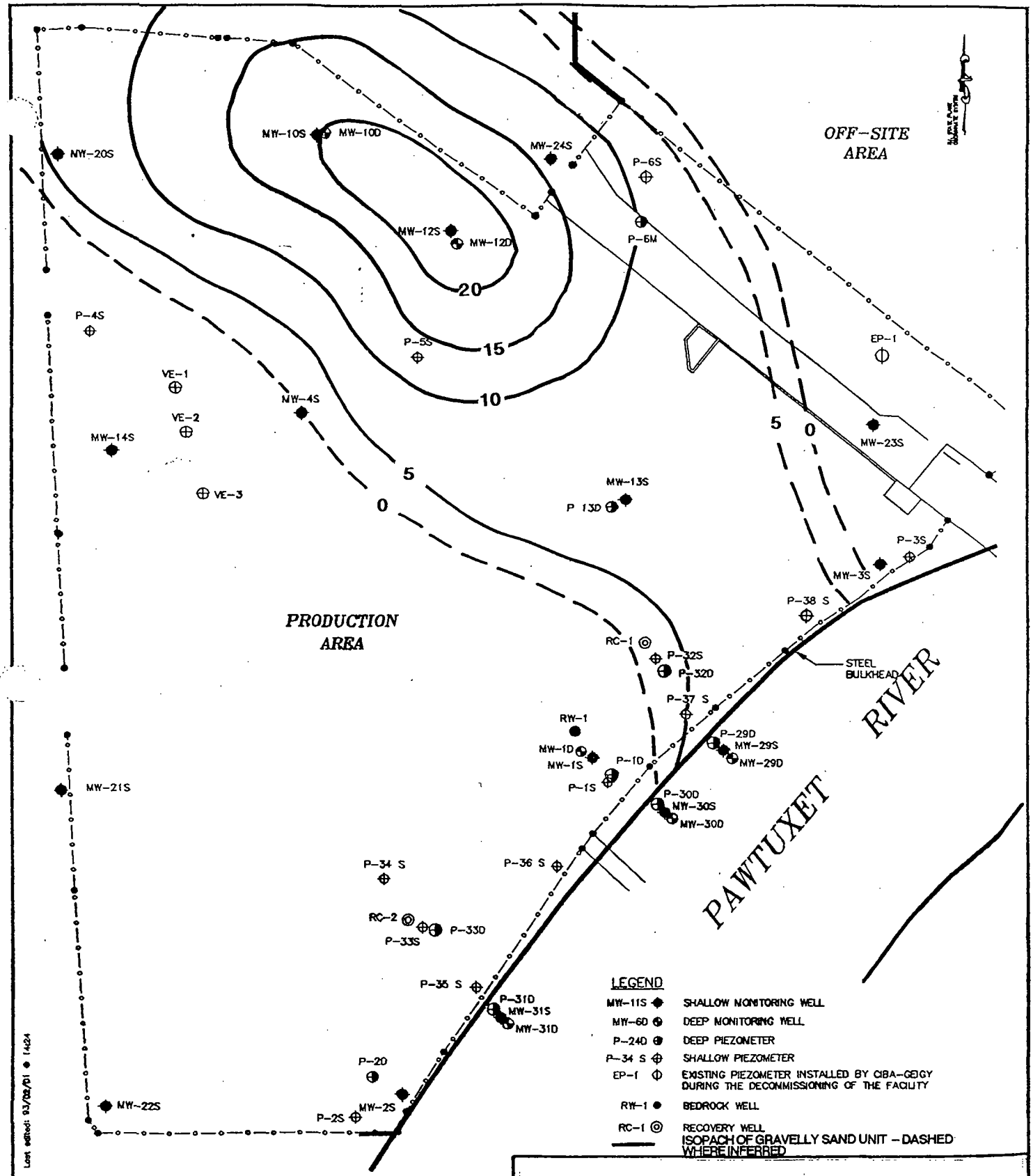
0 50 100 200
HORIZONTAL SCALE (FEET)

CROSS-SECTIONS F AND G
CIBA-GEIGY
CRANSTON, RHODE ISLAND

WOODWARD-CLYDE CONSULTANTS
ENGINEERING & SCIENCES APPLIED TO THE EARTH & ITS ENVIRONMENT
WAYNE, NEW JERSEY

DR. BY	WVB	SCALE AS SHOWN	DWG. NO. 74660026	PROJ. NO. 87X4660	
CK'D. BY	CLH	DATE APR 14, 1995	FIG. NO. 2-8		

File name: K:\CAD\87X4860\74660026.DWG Last edited: 95/04/14 @ 10:07



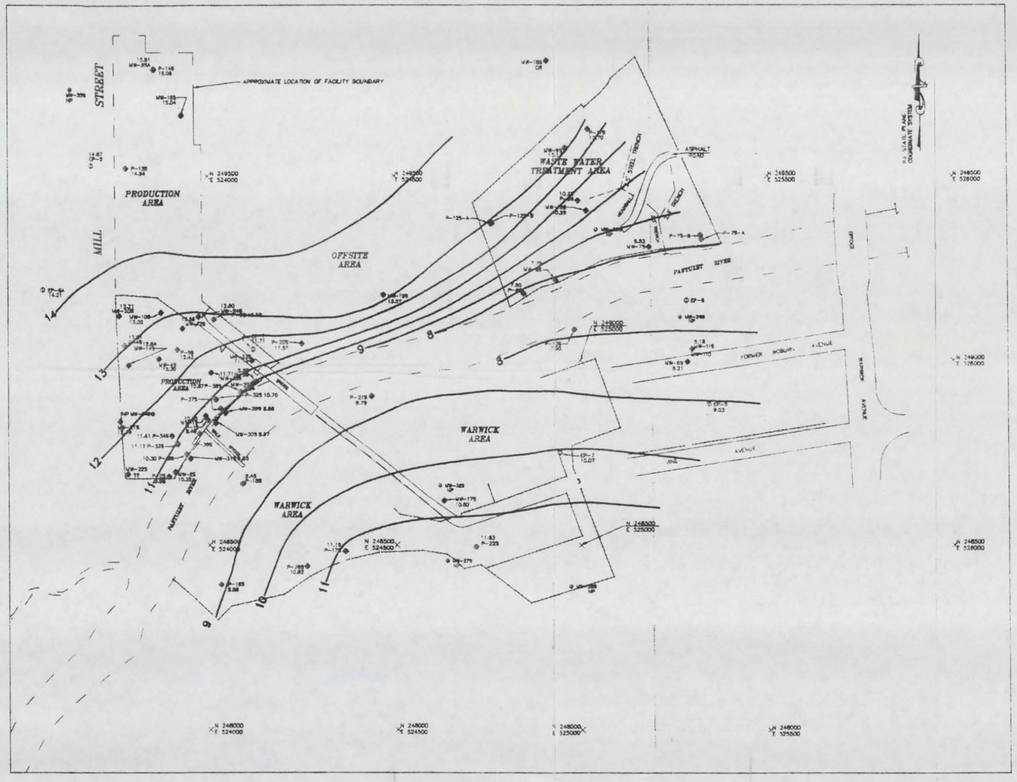
THICKNESS AND EXTENT OF GRAVELLY SAND UNIT IN THE PRODUCTION AREA

WOODWARD-CLYDE CONSULTANTS

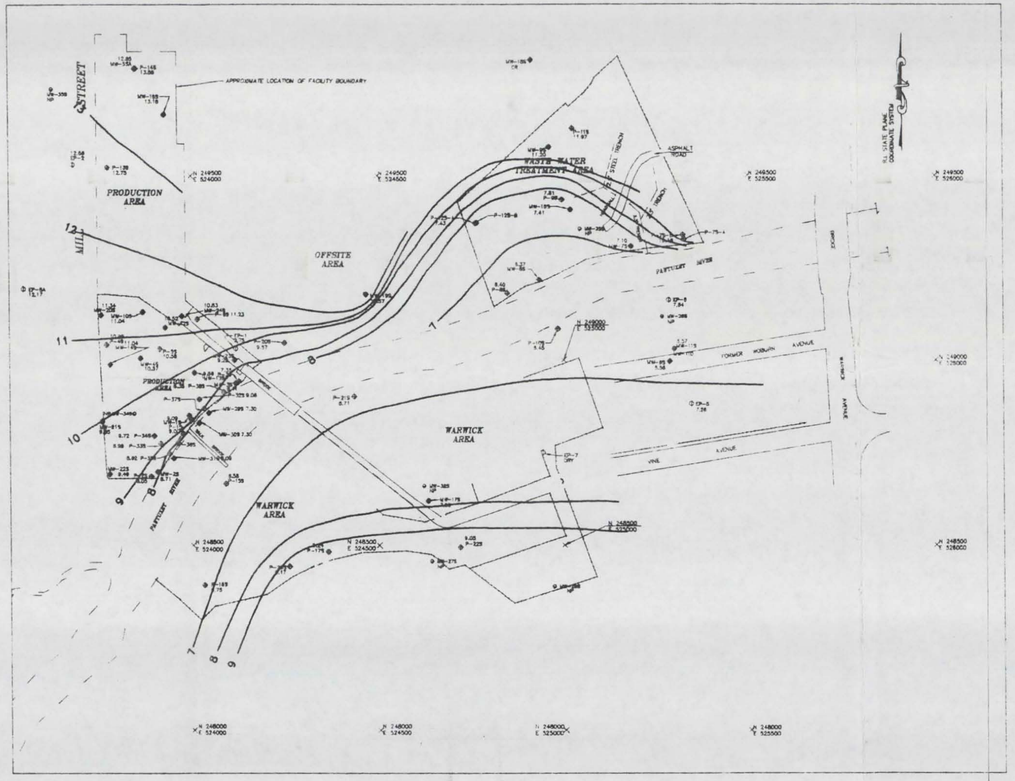
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
WAYNE, NEW JERSEY

DR.BY	MG	SCALE	1 : 720	PROJ.	87X4660
CK'D.BY	CLH	DATE	JAN 29 1993	FIG.NO.	2-9

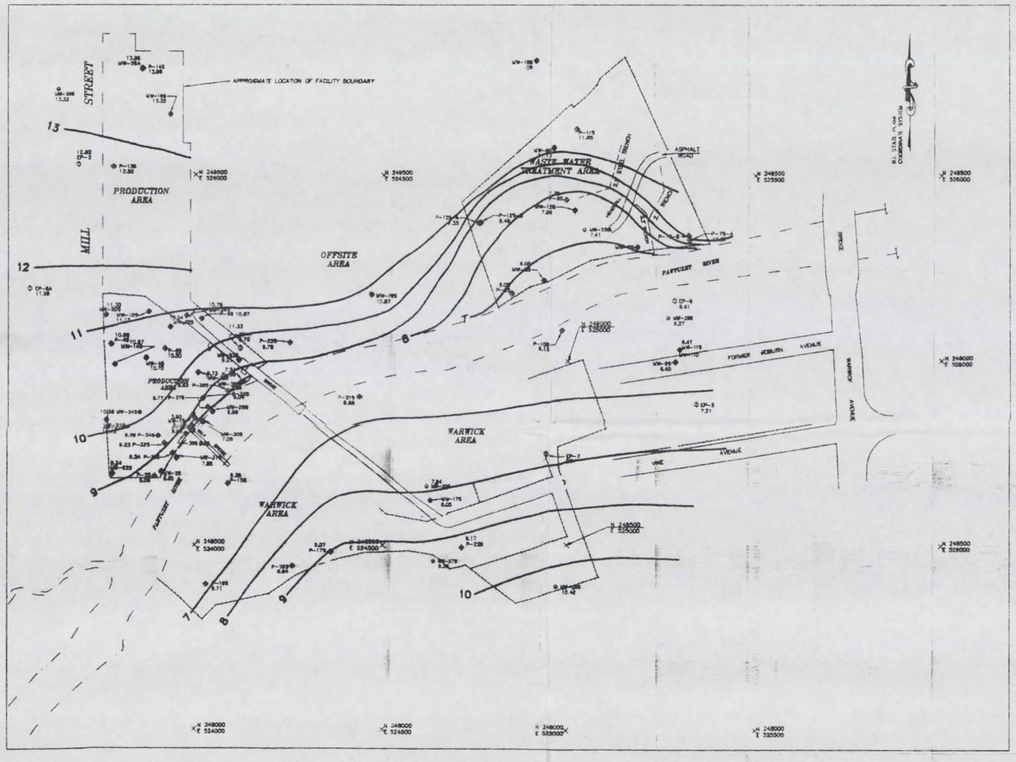
File name: E:\SMALL.DWG Last edited: 93/08/01 @ 1424



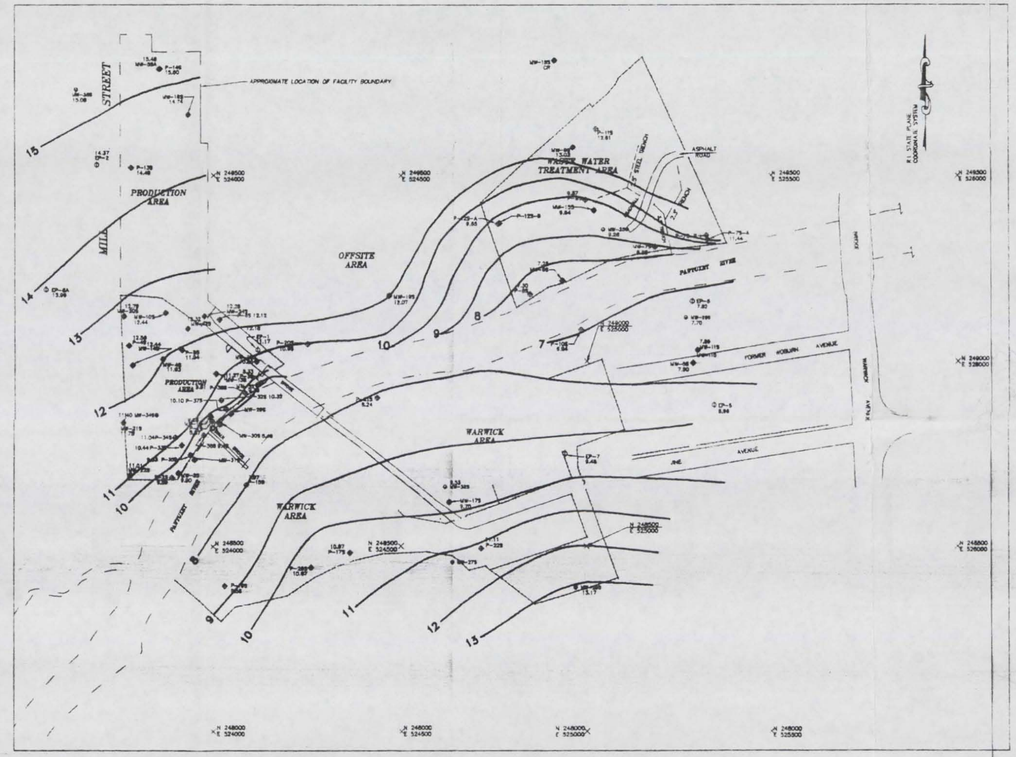
APRIL 29, 1993



JULY 29, 1993



OCTOBER 29, 1993



JANUARY 31, 1994

LEGEND

MW-11S ●	SHALLOW MONITORING WELL
P-32S ⊕	SHALLOW PIEZOMETER
EP-8A ⊖	EXISTING PIEZOMETER INSTALLED BY CIBA
NP	NOT PRESENT AT TIME OF MEASUREMENT
CR	COVER CRUSHED, PERMANENT CAP INSTALLED
??	ANOMALOUS DATA POINT
12 — 12	GROUNDWATER CONTOUR AT 1.0 FT INTERVALS
10.32	PIEZOMETRIC SURFACE ELEVATION

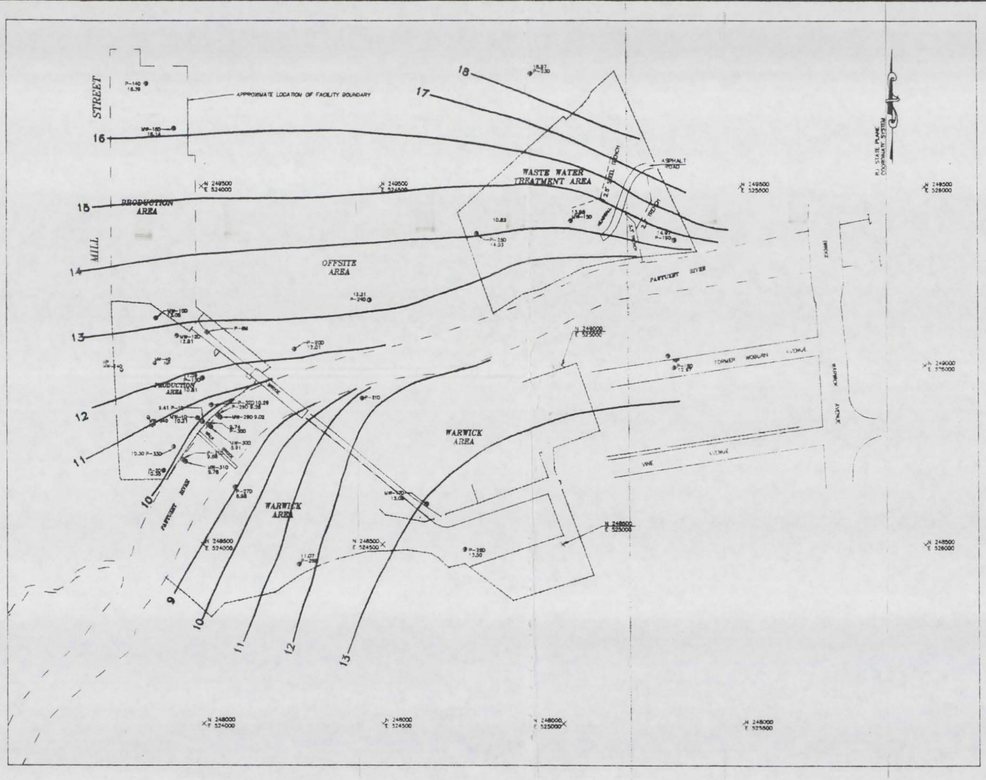
SHALLOW WATER TABLE CONTOURS
CIBA-GEIGY
CRANSTON, RHODE ISLAND

WOODWARD-CLYDE CONSULTANTS

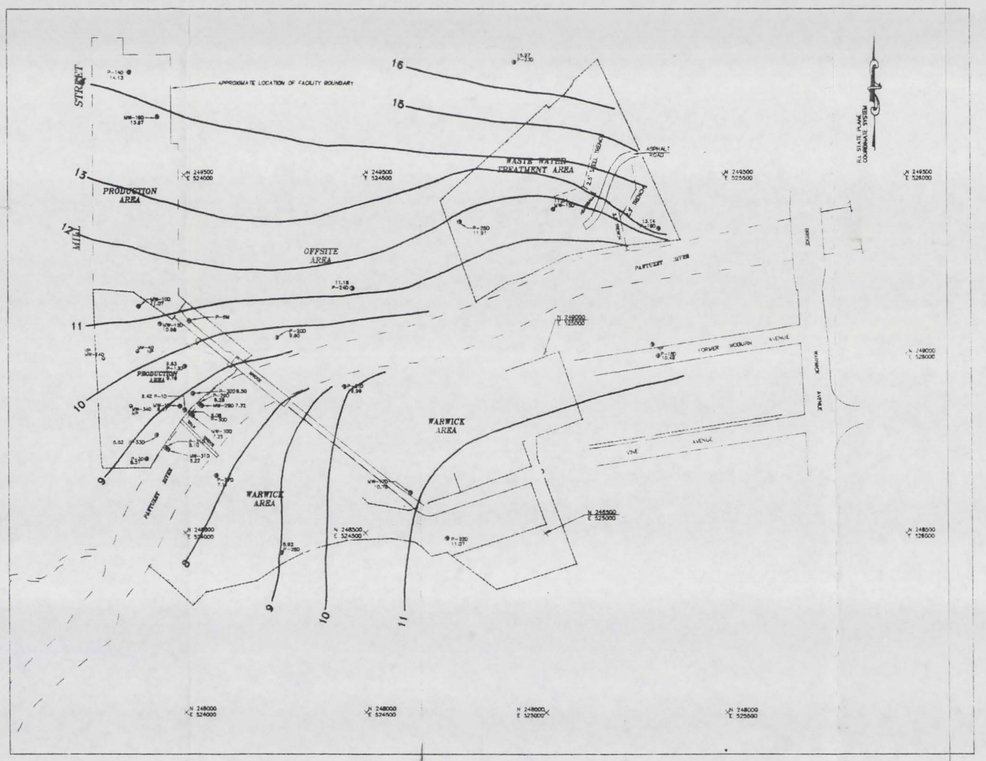
ENGINEERING & SCIENCES APPLIED TO THE EARTH & ITS ENVIRONMENT
WAYNE, NEW JERSEY

DR. BY	JL	SCALE	1"=200'	DWG. NO. 74660059	PROJ. NO. 87X4660
CK'D. BY	CLH	DATE	MAY 06, 1995	FIG. NO.	2-10

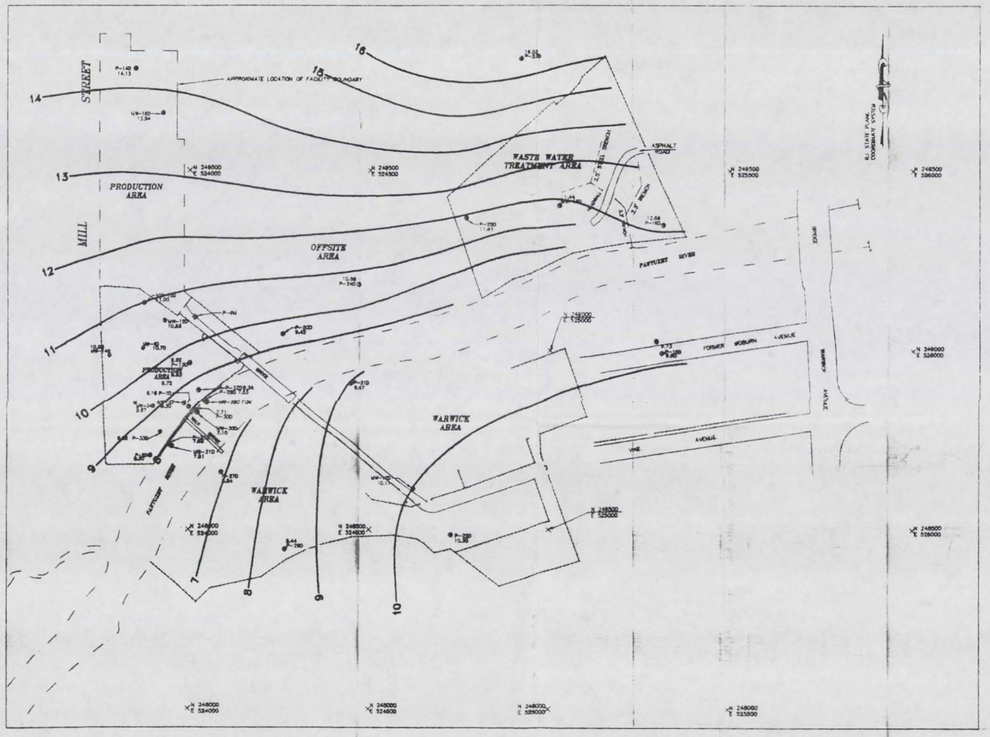
File name: K:\CADD\87X4660\74660059.DWG Last edited: 95/05/08 @ 19:05



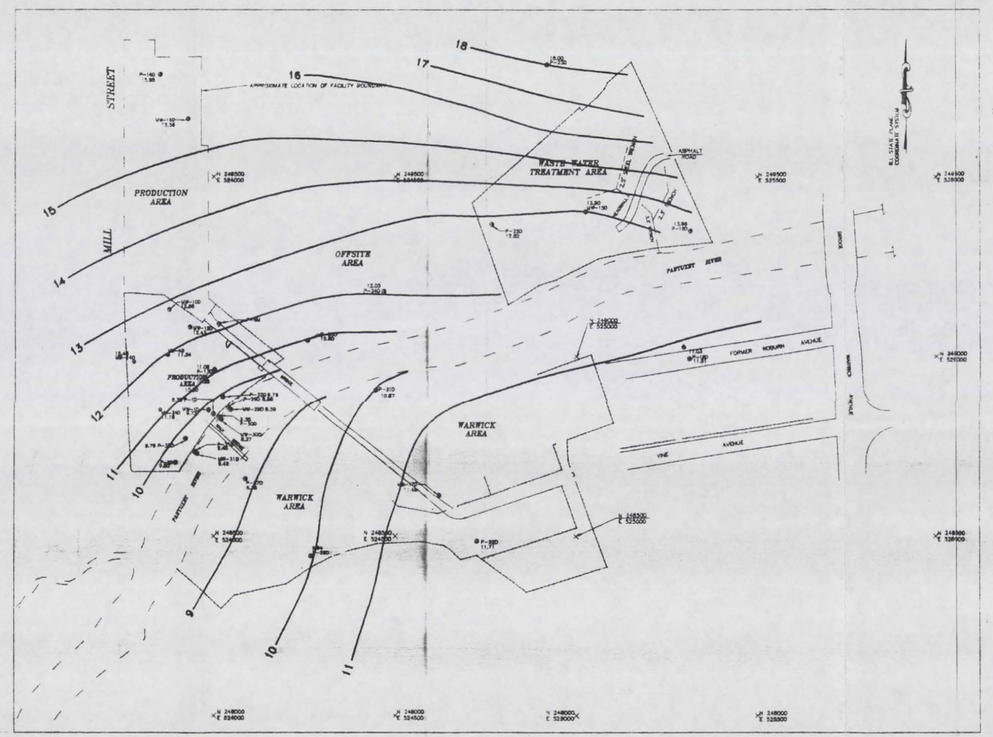
APRIL 29, 1993



JULY 29, 1993



OCTOBER 29, 1993



JANUARY 31, 1994

LEGEND

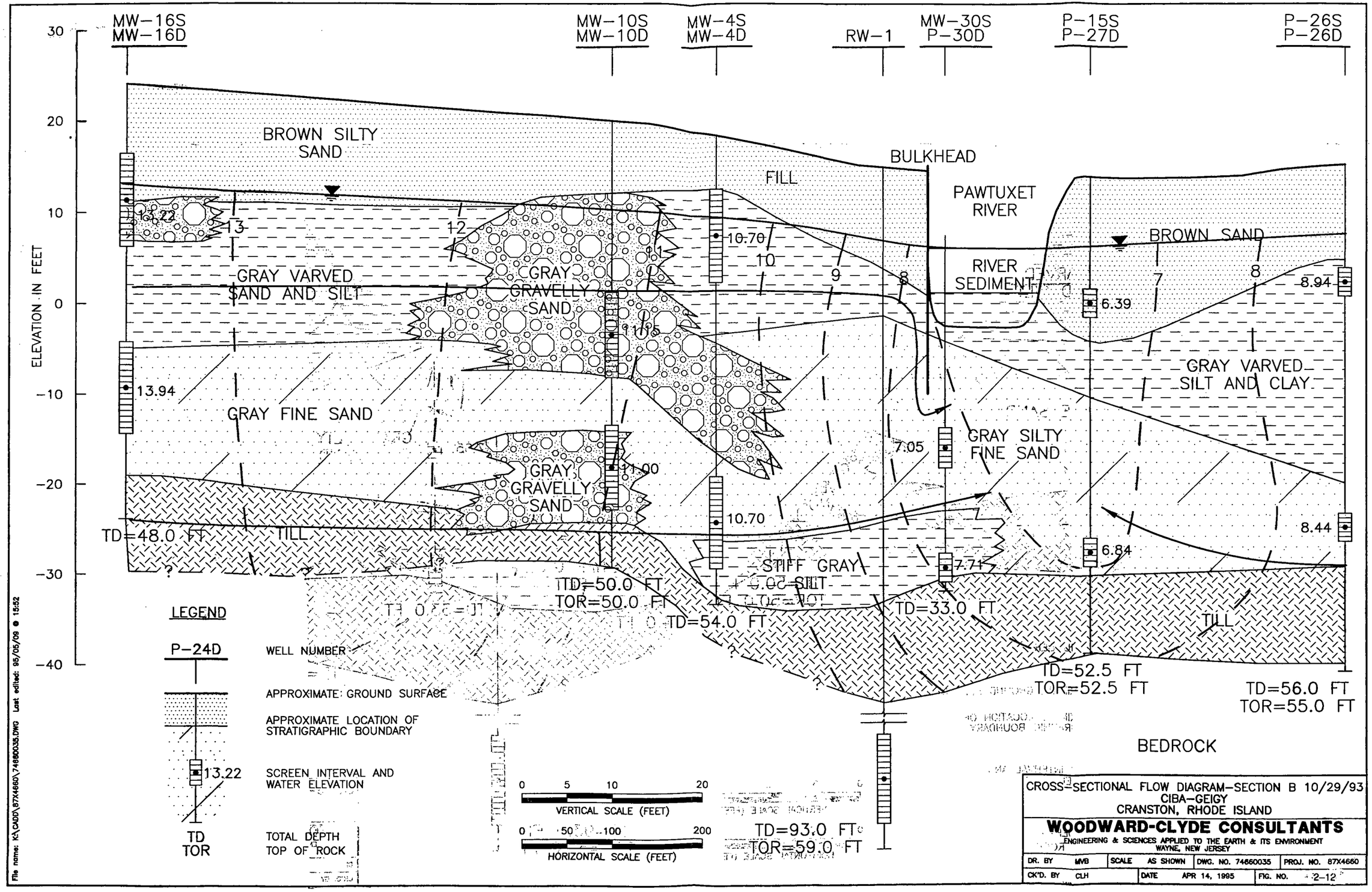
MW-6D	DEEP MONITORING WELL
P-240	DEEP PIEZOMETER
12 — 12	GROUNDWATER CONTOUR AT 1.0 FT INTERVALS
8.38	PIEZOMETRIC SURFACE ELEVATION

PIEZOMETRIC SURFACE OF THE DEEP OVERBURDEN
CIBA-GEIGY
CRANSTON, RHODE ISLAND

WOODWARD-CLYDE CONSULTANTS
ENGINEERING & SCIENCES APPLIED TO THE EARTH & ITS ENVIRONMENT
WAYNE, NEW JERSEY

DR. BY MVB	SCALE 1"=200'	DWG. NO. 74680033	PROJ NO. 87X4650
CK'D. BY CLH	DATE MAR 7, 1995	FIG. NO. 2-11	

File name: K:\CADD\87X4680\74680033.DWG Last edited: 95/09/06 @ 18:03

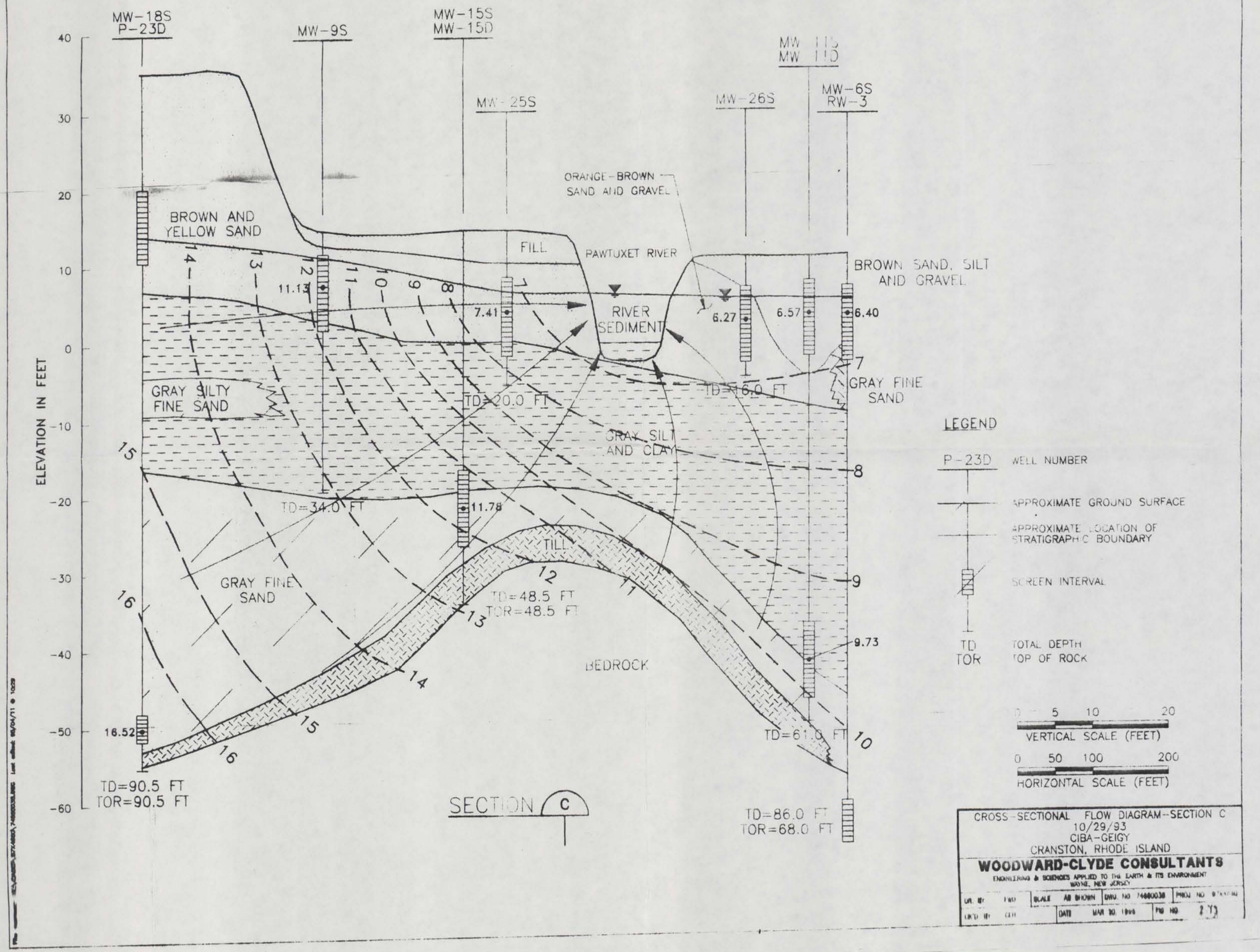


File name: K:\CADD\87X4660\74660035.DWG Last edited: 05/05/09 ● 15:52

CROSS-SECTIONAL FLOW DIAGRAM-SECTION B 10/29/93
CIBA-GEIGY
CRANSTON, RHODE ISLAND

WOODWARD-CLYDE CONSULTANTS
ENGINEERING & SCIENCES APPLIED TO THE EARTH & ITS ENVIRONMENT
WAYNE, NEW JERSEY

DR. BY	MVB	SCALE	AS SHOWN	DWG. NO. 74660035	PROJ. NO. 87X4660
CK'D. BY	CLH	DATE	APR 14, 1995	FIG. NO.	2-12



CROSS-SECTIONAL FLOW DIAGRAM--SECTION C
10/29/93
CIBA-GEIGY
CRANSTON, RHODE ISLAND

WOODWARD-CLYDE CONSULTANTS

ENGINEERING & SCIENCES APPLIED TO THE EARTH & ITS ENVIRONMENT
WAYNE, NEW JERSEY

DR. BY: FWD	SCALE: AS SHOWN	DWG. NO: 74680038	PROJ. NO: 87X7480
CH'D. BY: GH	DATE: MAR 30, 1994	FIG NO: 2 (7)	

3.1 OVERVIEW

This chapter describes the Solid Waste Management Units (SWMUs), Areas of Concern (AOCs), and Additional Areas of Investigation (AAOIs) in each of the three main areas of the Site. Based on the information Ciba submitted to USEPA and the information USEPA gathered during the Facility Assessment, twelve SWMUs and two AOCs were identified at the Site. Information about these SWMUs and AOCs is presented here and summarized in Table 1-2. The locations of the SWMUs and AOCs, and the media that were investigated, are shown on Figure 1-1.

Ciba identified two Additional Areas of Investigation (AAOIs) for completeness of study. No releases from these AAOIs are known, but the potential for a past release existed. The AAOIs identified include the Laboratory Building Waste Water Sump (AAOI-15), and the Maintenance Department Cleaning Area (AAOI-16). Information on the AAOIs also is presented here, summarized in Table 1-2, and shown on Figure 1-1.

The Order requires that SWMUs and AOCs and the wastes placed in them be characterized. The information to be provided includes the following:

for SWMUs and AOCs -

- location;
- type;
- design;
- operating practices;
- period of operation;
- age;
- physical condition;
- closure method;
- information sources;

for wastes -

- waste type;
- waste classification;
- quantity;
- chemical composition;
- toxicity;
- physical form;
- chemical characteristics; and,
- transformation products.

Ciba ceased all chemical manufacturing operations in May 1986 when the plant was closed. The plant closure included the removal of materials and residues, as well as the proper disposal of wastes and hazardous wastes. The structures associated with the SWMUs, AOCs, and AAOIs were dismantled. Therefore, except for SWMU-6 (Zinc Oxide/Soil Storage Pile), wastes were not available to be characterized, and physical descriptions of SWMUs and AOCs are based on historical information.

SWMUs, AOCs, and AAOIs within the Production Area, the Waste Water Treatment Area, and the Warwick Area are described in the following sections.

3.2 PRODUCTION AREA

3.2.1 SWMU-2: 6000-Gallon Hazardous Waste Storage Tank

SWMU-2 was a 6000-gallon above ground hazardous waste storage tank located in the tank farm just south of the railroad tracks in the Production Area (Figure 1-1). The tank stored liquid hazardous waste mixtures generated at the facility including process waste water containing acetone, toluene, monochlorobenzene, ethanol, isopropanol, naphthalite, xylene, heptane, and methanol. The carbon steel vertical tank was 8 feet in diameter and 17 feet high; it was supported by a one-foot thick reinforced concrete slab, and was surrounded by a secondary containment dike with a capacity of 8000 gallons (Versar, Inc., 1988).

Liquid hazardous wastes were transferred regularly from SWMU-2 to railroad cars for off-site disposal. Approximately 260,000 gallons of RCRA-regulated wastes were removed from SWMU-2 and SWMU-3 per year (Versar, Inc., 1988). No releases from SWMU-2 were known or suspected during its period of operation. The hazardous waste storage tank, including the pumps and piping associated with loading the tank cars, were inspected regularly. Drainage from the diked enclosure originally flowed to the facility's waste water treatment plant. However, in compliance with federal hazardous waste storage requirements, this drainage line was sealed off; subsequently, water from the sump within the dike was pumped out for off-site disposal.

SWMU-2 was used from 1981 through 1986 (when the facility was decommissioned). Closure of SWMU-2 was performed by OH Materials in 1986 using the standard operating procedures described in the Storage and Treatment Facility Closure Plan (RCRA Part B Permit Application Submission, 1985). Decommissioning of the unit was verified by a professional engineer from Bechtel National Inc. The closure was approved by RIDEM in 1987. The physical condition of this SWMU at the time of closure is not known.

3.2.2 SWMU-3: 7500 Gallon 90-Day Storage Tank

The above-ground 7500-gallon waste accumulation tank was located in the same tank farm as SWMU-2 (Figure 1-1). The stainless steel accumulation tank was used to store flammable liquids for periods of less than 90 days. The vertical tank was 8.5 feet in diameter and 17 feet high, and was enclosed (along with three other tanks) by a containment dike having a capacity of 25,000 gallons.

The contents of this tank were pumped regularly into railroad tank cars together with wastes from SWMU-2, for shipment to an off-site disposal facility. Approximately 260,000 gallons of RCRA regulated wastes were removed from SWMU-3 and SWMU-2 per year (Versar, Inc., 1988). No releases were known or suspected during the period of operation.

The accumulation tank operated during 1985 and 1986 (until the facility was decommissioned). Closure of SWMU-3 was performed by OH Materials in 1986 using the standard operating procedures described in the Storage and Treatment Facility Closure Plan (RCRA Part B Application Submission, 1985). Decommissioning was verified by a professional engineer from Bechtel National Inc. The closure of SWMU-3 was approved by RIDEM in 1987. The physical condition of the SWMU at the time of closure is not known.

3.2.3 SWMU-4: Trash Compactor Station

SWMU-4 was a trash compactor station located on a concrete pad (21 feet by 36 feet) north of Building 27 in the Production Area. There were two compactors, of 30 and 55 cubic yards capacity, respectively. The compactors handled packaging material, waste paper, and washed fiber drums. No process wastes were reportedly put into the compactor (Versar, Inc., 1988). Compacted materials were taken to a sanitary landfill or incinerated (Versar, Inc., 1988).

There were no known or suspected releases from this SWMU. Any spills from the compactors would have collected into a drainage sump and then flowed to the waste water treatment plant.

The compactors were used from 1972 until the plant ceased operations in May 1986 and were in good physical condition during their period of operation. Media of Concern from this SWMU were not sampled during the Facility Assessment or the Preliminary Investigation. Investigation of this unit is not required by the Order.

3.2.4 SWMU-7: Chlorosulfonic Acid Release Area

SWMU-7 is an area (about 10 feet wide by 20 feet long, and 1 foot deep) where, in 1961, approximately 500 gallons of chlorosulfonic acid were spilled from a tanker

truck (Figure 1-1). The release area was located in the area bordered by the railroad spur adjacent to the former main tank farm in the Production Area. Soils within the release area were neutralized and subsequently excavated to accommodate new tank farm foundations in the Production Area. Little more is known about the chlorosulfonic acid release at SWMU-7. For example, it is not known what was used to neutralize the spill or how much soil was removed.

3.2.5 SWMU-8: Prussian Blue Release Area

Blue stained soil was excavated in 1961 while constructing the foundation for the new tank farm. Approximately 300 cubic yards of soil were removed and replaced with new fill for the storage tank foundation. No information exists regarding a release at SWMU-8. However, it is believed that the staining was caused by a spill of potassium ferrocyanide (Prussian Blue).

The staining was first noticed around 1956. Laboratory analysis to confirm the presence of Prussian Blue was not performed. Reports of the incident are no longer available.

In the 1960s, during the installation of the waste water piping system, another quantity of blue stained soil was excavated just east of Building 24. It is not known where the excavated materials were disposed.

3.2.6 SWMU-11: Toluene Waste Water Release Area

SWMU-11 was a subsurface sump beneath Building 11 from which waste water containing toluene was released. Building 11, a facility production building, was razed in October 1983 (Figure 1-1). During demolition, groundwater sampled from beneath the building's sump contained low concentrations (less than 1 ppm) of toluene. The subsurface sump at SWMU-11 was made of concrete and had a capacity of 300 gallons. The sump functioned as an overflow reservoir, and contained a constant amount of water that was normally pumped to the Waste Water Treatment Plant (Versar, Inc., 1988). Ciba estimated that the toluene loss was between 9 and 90 pounds (based on normal building flow conditions and the probable concentration of toluene in the waste stream). Toluene was a primary organic solvent used in the facility's manufacturing processes.

3.2.7 AOC-13: Process Building Area

Chemical manufacturing took place at the Site from 1930 to 1986. Alrose Chemical Company, Geigy Chemical Company, and CIBA-GEIGY Corporation owned and operated chemical manufacturing operations during that time. Only limited information is available about the operations and processes conducted by Alrose Chemical and Geigy Chemical. Most of the chemical manufacturing operations were

located in the southern half of the Production Area (Figure 1-1). This entire area has been identified as AOC-13. All of the structures in this area have been razed and much of the area has been regraded.

3.2.8 AOC-14: Atlantic Tubing and Rubber Company Property

In 1981, Ciba purchased 23 acres of property adjoining the Site in Cranston, Rhode Island from the Atlantic Tubing and Rubber Company. This property, AOC-14, is located to the west of the Production Area (Figure 1-1). All buildings on AOC-14 property were razed but Ciba did not use or redevelop the land. Ciba has no records of any hazardous waste usage/management activities conducted by the Atlantic Tubing and Rubber Company. Because there are no known or suspected releases from this area, investigation of AOC-14 was not required by the Order. AOC-14 was not investigated as part of the RFI.

3.2.9 AAOI-15: Laboratory Building Waste Water Sump

As described in the Current Assessment Summary Report, Ciba identified a waste water sump in the northern part of the Production Area as an additional area of investigation which had not been identified as a SWMU in the Order. The sump (AAOI-15) is located near Building 20 (Figure 1-1). The gravity sump was used during normal operations in the laboratory building and drained to sanitary sewer lines that discharged to the Cranston POTW. Design information about the sump is not available. The physical condition of the sump is not known. The age of the sump is not known. The sump operated from 1961 until 1987 (Ciba-Geigy, 1990).

3.3 WASTE WATER TREATMENT AREA

3.3.1 SWMU-10: Waste Water Pipeline Break

SWMU-10 was the site of a waste water pipeline break in the Waste Water Treatment Area. On September 7, 1983, an underground pipeline feeding one of three equalization tanks ruptured (Figure 1-1). Pre-treated neutralized waste water from the equalization tanks normally passed through a clarifier before discharging to the Cranston publicly owned treatment works (POTW). The break occurred at a "Y" splice located before the equalization tanks and five feet below the ground surface. About 50,000 gallons of waste water escaped in the 90-minute period before the flow could be shut off (Versar, Inc., 1988). The discharge reached the surface, flowed east, around the 1.5 million gallon equalization tank, into a small pond and then was diverted to the Pawtuxet River via Outfall 005. (The RFA refers to this outfall as Outfall 001, but verbal communications with former plant personnel indicates that Outfall 005 received the waste water.)

The pH of the released waste water was 8.5; the chemical oxygen demand (COD) was 1010 ppm. This discharge contained the following estimated quantities: acetone (31 pounds), isopropyl alcohol (45 pounds), toluene (7 pounds), xylene (1.7 pounds), zinc (0.25 pounds), and nitrobenzene (0.125 pounds). On the day of the release, surface water samples of the river were collected by RIDEM. Toluene was detected in both the upstream (1.1 ppm) and downstream (2.0 ppm) samples.

3.3.2 SWMU-12: Waste Water Treatment Plant

SWMU-12 was a biological waste water treatment plant that was used during facility operations to treat large volumes of waste water and to minimize the environmental impact of water discharged to the Pawtuxet River (Figure 1-1).

The Waste Water Treatment Plant was constructed in 1972. Ciba was issued a NPDES permit (RI 0001171) in 1974 to operate the plant. The plant began operation in November 1975 and continued through July 1983 under the limitations of the Federal Clean Water Act. In July 1983, Ciba was connected to the Cranston POTW. After the tie-in, process water was pre-treated and analyzed before being discharged to the city's POTW. SWMU-12 operated until the facility was decommissioned and razed in 1986.

Releases of waste water from the treatment facility occurred occasionally before the tie-in to the Cranston POTW was complete. Biological trickling towers were used at the facility from 1970 until 1983. Occasional sump overflows from these towers resulted in discharges to the river. Influent to the trickling towers routinely contained volatile and semi-volatile organic compounds. Additional releases from SWMU-12 also have been documented, including discharges that exceeded the NPDES permit requirements. Discharges exceeding the permitted maximum have been reported for zinc, BOD, and phenols. For two releases, compounds not authorized by the NPDES permit (e.g., chloroform) were discharged to the river.

3.4 WARWICK AREA

3.4.1 SWMU-1: Hazardous Waste Storage Area

SWMU-1 was a hazardous waste storage area located in the Warwick Area (Figure 1-1). SWMU-1 had a maximum storage capacity of 768 55-gallon drums; the unit typically stored 300 to 400 drums at any given time. The hazardous waste storage area was asphalt-lined, diked, and surrounded by a 6-foot high chain link fence; it was 42 feet by 58 feet, with a 32-inch high concrete containment dike capable of holding 48,000 gallons (Ciba-Geigy, 1986; Ciba-Geigy, 1985).

SWMU-1 was used from 1981 through 1986 solely for storing various hazardous

wastes in drums (including flammable liquids and solids, corrosive liquids and solids, organic mixtures and solids, non-hazardous organic mixtures, and chloroform). SWMU-1 was decommissioned by OH Materials using the standard operating procedures described in the Storage and Treatment Facility Closure Plan (RCRA Part B Permit Application Submission, 1985). Closure of this unit was verified by a professional engineer from Bechtel National Inc. The closure was approved by the RIDEM in 1987. At the time of closure, this SWMU was in good physical condition.

SWMU-1 was decommissioned prior to the RFA sampling. Media of Concern were not sampled from this unit during either the RFA or the Preliminary Investigation. No evidence of releases were observed by the USEPA contractors during the RFA sampling visit. The potential for exposure to any waste previously managed in the unit was considered negligible by the USEPA contractors Because there are no known releases from this area, investigation of this unit was not required by the Order. SWMU-1 was not investigated as part of the RFI.

3.4.2 SWMU-5: River Sediment Storage Area

SWMU-5 was a storage area for river sediment. In 1971, sediment was dredged from the Pawtuxet River from the reach between the Production Area's pedestrian and vehicular bridges. Dredging took place as part of the removal of the original cofferdam/waste water outfall. The sediment was stockpiled adjacent to the river in northern most corner of the Warwick Area to dewater (Figure 1-1) (Versar, Inc., 1988). Approximately 6630 cubic yards of sediment were stockpiled until December 1976, when the material was removed from the facility. The area was brought back to grade in 1977 as part of the flood plain restoration required under the Wetlands Act to permit construction of the equalization tanks for Ciba's waste water treatment system. The sediment occupied an irregularly shaped area. Historical maps and other documents do not provide definitive information about the shape and location of SWMU-5. The river sediments were not chemically analyzed during the dredging and storage operation.

3.4.3 SWMU-6: Zinc Oxide/Soil Storage Pile

SWMU-6 is a soil pile containing residues of zinc oxide. In the late 1960s, 140,000 pounds of zinc oxide spilled from a broken rail car that was on the railroad siding near Buildings 32 and 33 in the Warwick Area. The zinc oxide was transferred to another rail car. The spilled zinc oxide was cleaned up, and paved areas were swept as part of normal plant maintenance. After the spill, road sweepings from in and around the railroad spur in the Warwick Area contained some zinc oxide residue. Those sweepings were used to form a drainage berm now identified as SWMU-6.

The soil berm was not removed during decommissioning activities and remains stored on-site at its original location. The soil pile, approximately 50 feet long by 7 feet

wide by 2 feet high, contains about 25 cubic yards of material. The pile contains about 10 percent zinc oxide and can be identified by the lack of vegetative growth. Surface runoff from this area discharges to the river via Outfall 003.

Zinc oxide is not a RCRA-regulated waste, and was, therefore, not characterized as part of this source characterization.

3.4.4 SWMU-9: Waste Water Pipeline Break Area

SWMU-9 was the site of a waste water pipeline break in the Warwick Area. On January 12, 1982, a break in the main raw waste water transfer pipeline (in the Warwick Area) leading to the facility's waste water treatment plant resulted in a discharge to the Pawtuxet River (Figure 1-1). Remedial measures were taken to reduce flow in the line and permit repairs. Approximately 24,000 gallons of raw waste escaped over a four hour period (Versar, Inc., 1988). The raw waste entered the surface water runoff catchment system and discharged into the Pawtuxet River via Outfall 004.

Laboratory analysis of the material spilled or the media impacted was not performed after the release. The influent to the waste water treatment plant typically contained halogenated and non-halogenated solvents and other organic compounds (e.g., materials routinely used in the chemical manufacturing process). The pH of the river both upstream and downstream of the spill's entry was measured by Ciba personnel; both readings had a pH of 6. The pH of the discharge varied from 4 to 12 (Versar, Inc., 1988). The spill resulted in a period of bypass as defined in the facility's NPDES permit.

3.4.5 SWMU-16: Maintenance Department Cleaning Area

As described in the Current Assessment Summary Report, Ciba identified a maintenance department cleaning area as an additional area of investigation (AAOI) requiring further investigation. Based on the results of Phase I investigations, this area was redesignated as a SWMU. The maintenance department cleaning area (SWMU-16) was located near the southwest corner of former Building 23 (Figure 1-1). Production machinery (such as portable filters) was brought to this area and steam cleaned. Rinse water was not collected (or analyzed) and probably drained to the nearby surface water catch basin.

The age of SWMU-16 is not known. It was operated from the mid-1960s until 1986 (Ciba-Geigy, 1990). The design and physical condition of the catch basin is not known.

4.0 RESULTS OF CONTAMINATION CHARACTERIZATION

4.1 OVERVIEW

This chapter presents the results of the contamination characterization. Results are discussed by media, area, and analyte group. In general, organic analytes detected with the greatest frequency are discussed. Inorganic analytes occur in nature, and their presence does not necessarily indicate contamination. Therefore, inorganic analytes are discussed only if they are toxic and frequently occur above background levels as determined through the screening process described in the PHERE (Section 6.3).

Summaries for media contamination in each area are presented as follows:

- Section 4.2 presents the results of groundwater contamination;
- Section 4.3 presents the results of soil contamination;
- Section 4.4 presents the results of on-site surface water contamination; and
- Section 4.5 present the results of on-site sediment contamination.

Information regarding the transport and fate of the contamination identified in the contamination characterization is presented in Chapter 5.

4.2 GROUNDWATER CONTAMINATION

This section presents the results of the groundwater contamination characterization; specifically, this section discusses the following:

- groundwater sampling;
- background groundwater contamination;
- Production Area groundwater contamination;
- Waste Water Treatment Area (WWTA) groundwater contamination; and
- Warwick Area groundwater contamination.

4.2.1 Groundwater Sampling

Groundwater was sampled from monitoring wells during Phases I and II of the RFI and also during the stabilization investigation. This section presents a summary of monitoring well locations, sampling methodologies, and analyses.

4.2.1.1 Monitoring Well Locations

As discussed in Section 2.3, monitoring wells were installed during the RFI in four areas - Background, Production Area, Waste Water Treatment Area, and Warwick Area. Locations of these monitoring wells are shown on Figure 2-1.

Background
Monitoring wells were installed in locations hydraulically upgradient from the Site based on water level measurements. Samples from these wells were analyzed to determine the quality of groundwater entering the Site from off-site locations. Background wells include shallow monitoring wells MW-18S, MW-19S, MW-27S, MW-28S, MW-35S, and bedrock well RW-4.

Production Area
To characterize groundwater contamination in the Production Area, shallow monitoring wells were installed at and hydraulically downgradient from SWMUs -2 (MW-10S, MW-10D), SWMU-7 (MW-12S), SWMU-8 (MW-13S), and SWMU-11 (MW-4S, MW-14S, MW-20S, MW-21S), AAOI-15 (MW-5S, MW-16S) and AOC-13 (MW-1S, MW-2S, MW-3S, MW-22S, MW-23S, MW-24S, MW-29S, MW-30S, MW-31S). Deep overburden monitoring wells were installed at SWMU-2 (MW-12D), SWMU-7 (MW-12D), and AAOI-15 (MW-16D) and hydraulically downgradient from AOC-13 (MW-1D, MW-29D, MW-30D, MW-31D). One bedrock monitoring well (RW-1) is located hydraulically downgradient from AOC-13.

Waste Water Treatment Area
To characterize groundwater contamination in the WWTA, monitoring wells were installed at and hydraulically downgradient from SWMU-10 and SWMU-12. A shallow monitoring well located in the approximate area of a waste water pipeline break in SWMU-10 (MW-9S). Shallow monitoring wells are located hydraulically downgradient from SWMU-10 (MW-7S and MW-8S). Shallow and deep overburden monitoring wells are located in SWMU-12 at the approximate location of the former trickling towers (MW-15S and MW-15D) and hydraulically downgradient of SWMU-12 (MW-25S). Bedrock monitoring well RW-2 was installed to evaluate water quality in the bedrock.

Warwick Area
To characterize groundwater contamination in the Warwick Area, monitoring wells were located in and downgradient from SWMU-5 and SWMU-16. Shallow monitoring wells, a deep overburden well, and a bedrock well are located in the area of SWMU-5 (MW-11S, MW-6S, MW-15D, and RW-3) the former river sediment storage area. A shallow monitoring well is hydraulically downgradient from SWMU-5 (MW-26S). Shallow and deep overburden monitoring wells are located in the area of SWMU-16 (MW-17S and MW-17D), the former maintenance department area. A shallow well is located hydraulically downgradient from SWMU-16 (MW-32S).

4.2.1.2 Sampling Methodologies and Analyses

Groundwater was sampled from monitoring wells in accordance with the procedures specified in the QAPP - Supplement dated January 1992. These samples were submitted to the laboratory and analyzed for Appendix IX compounds and "fingerprint compounds". Fingerprint compounds are a list of compounds which are believed to be unique to Ciba's former operations (Table 4-1). Three groundwater sampling events were conducted during Phase I and two sampling events were conducted during Phase II. Table 4-2 presents a summary of the Phase II groundwater sampling program. As agreed by USEPA, groundwater in the Production Area was not sampled during Phase II but will be sampled and analyzed during Stabilization activities.

4.2.2 Background Groundwater Contamination

The concentrations of analytes detected in groundwater samples from the background locations are summarized in Tables 4-3 and 4-4. Statistical summaries are provided at the end of these tables (and the other summary tables referenced in this section) that list the following:

- the number of times an analyte was detected;
- the average detected concentration;
- the average reported concentration (using detected concentrations and one half the detection limit for non-detected analytes);
- the maximum detected concentration; and
- the minimum detected concentration.

All of the background groundwater data including detection limits for analytes not detected, are presented in Appendix 4-A.

4.2.2.1 Volatile Organic Compounds - Background Groundwater

Low levels of volatile organic compounds (VOCs) were detected sporadically in samples of background groundwater (Table 4-3). Only two VOCs were detected in shallow background wells. Chlorobenzene (estimated at 2.1 ppb) was detected in one of four samples from the well located between the Production Area and WWTA (MW-19S). Ethylbenzene (10 ppb) was detected in one of two samples from the well upgradient from the Warwick Area (MW-28S).

Toluene (estimated at 3.5 ppb) was detected in one of three samples from the background bedrock well (RW-4).

4.2.2.2 Semi-volatile Organics - Background Groundwater

Polycyclic aromatic hydrocarbons (PAHs) were the most frequently detected semi-volatile organic compounds (SVOCs) from shallow background monitoring wells (Table 4-3). These compounds were generally found in low concentrations (less than 50 ppb total). One exception was 480 ppb of naphthalene detected in the well located between the Production Area and WWTA (MW-28S) in August 1993. The reported naphthalene concentration was 11 ppb in the most recent sampling event (May 1994). No fingerprint compounds were detected in the background shallow monitoring wells.

No SVOCs (including fingerprint compounds) were detected in the background bedrock monitoring well (RW-4).

4.2.2.3 PCBs - Background Groundwater

PCBs were not detected in any samples collected from the background monitoring wells.

4.2.2.4 Pesticides - Background Groundwater

Organochlorine pesticides (0.063 ppb or less) were detected in samples from shallow and bedrock background monitoring wells collected in January 1991 (Table 4-3). No pesticides were detected in subsequent sampling events.

4.2.2.5 Herbicides - Background Groundwater

Herbicides were not detected in background monitoring wells.

4.2.2.6 Chlorinated Dioxins and Furans - Background Groundwater

Total octachlorodibenzodioxin (estimated at 0.0037 ppb) was detected in one sample from a well located between the Production Area and the WWTA (MW-19S) (Table 4-3).

Total heptachlorodibenzofuran (estimated at 0.00052 ppb) was detected in one of two samples from a monitoring well located upgradient of the west end of the Warwick Area (MW-27S).

4.2.2.7 Inorganics - Background Groundwater

Inorganic data for background groundwater samples is summarized in Table 4-4. Nearly all of the inorganic analytes for which these samples were analyzed were detected. Because inorganic analytes occur naturally, their presence does not necessarily indicate contamination.

4.2.2.8 Summary of Background Groundwater Contamination

Low levels of VOCs (generally less than 10 ppb) and SVOCs (generally less than 50 ppb) were detected in shallow groundwater at background locations (Table 4-3). Pesticides, dioxins and furans were detected sporadically in shallow groundwater at background locations. Groundwater in bedrock at the background location sampled was essentially free of contaminants.

4.2.3 Production Area Groundwater Contamination

The concentrations of analytes detected in groundwater samples from the Production Area are summarized in Tables 4-5 through 4-10. All of the Production Area groundwater data including detection limits for analytes not detected, are presented in Appendix 4-A.

4.2.3.1 VOCs - Production Area Groundwater

VOCs were detected repeatedly in the shallow wells in the Production Area. Exceptions to this are samples from a well at the far north end of the Production Area (MW-5S), and wells at the north end of the process building area (MW-10S, MW-20S, MW-24S). The VOCs detected most frequently in the shallow wells were chlorobenzene, ethylbenzene, xylenes, and toluene (Table 4-5).

Chlorobenzene was detected in concentrations greater than 4 ppm in the shallow wells hydraulically downgradient of the Production Area (MW-1S and MW-2S) (Figure 4-1). Lower concentrations of chlorobenzene were detected in many of the other shallow wells in the Production Area.

Ethylbenzene (several hundred ppb) was detected in the shallow wells in the areas of SWMU-11, SWMU-7, and SWMU-8. The highest concentration of ethylbenzene (1.1 ppm) was detected in a sample from a shallow well hydraulically downgradient from these three SWMUs (MW-1S) (Figure 4-2).

Xylenes were also detected in shallow well samples from SWMU-11, SWMU-7, and SWMU-8, but the concentration distribution is different from that of ethylbenzene. The highest concentrations of xylenes (7.8 ppm m & p xylene) were detected in shallow wells in SWMU-7 and SWMU-11 (Figure 4-3).

Toluene was detected in concentrations greater than 10 ppm in shallow wells in the area of SWMU-11 (Figure 4-4). Crossgradient (MW-12S) and downgradient (MW-2S and MW-30S) of SWMU-11, toluene concentrations decrease by one to two orders of magnitude.

Most VOCs detected in deep overburden wells were below 5 ppb (Table 4-6). Notable exceptions are chlorobenzene (estimated at 230 ppb) in a well along the bulkhead (MW-31D), and xylenes (up to 130 ppb) in the deep overburden well in SWMU-7 (MW-12D).

Chlorobenzene (estimated at 4.2 ppb) was the only VOC detected in the bedrock well (Table 4-7).

4.2.3.2 SVOCs - Production Area Groundwater

Di- and trichlorobenzenes (up to 230 ppb) were detected repeatedly in shallow wells in SWMU-11 and downgradient shallow wells (MW-1S and MW-2S) (Table 4-5).

Various phenols were detected in shallow wells in SWMUs 7, 8 and 11, downgradient wells MW-1S, MW-2S, and to a lesser extent, downgradient well MW-30S. Chloro- and methylphenols were detected most frequently. The highest concentrations (up to 1,200 ppb) were detected in wells in SWMU-11.

Several PAHs were detected in shallow wells in the Production Area. All but one of the PAHs were detected at levels below 10 ppb. Naphthalene was detected at a concentration of 240 ppb in SWMU-11 well MW-21S. This analyte was detected at much lower concentrations (26 ppb or less) in other shallow wells in the Production Area.

Other SVOCs that were detected repeatedly in shallow well samples include benzyl alcohol and a fingerprint compound, Irgasan DP-300. Benzyl alcohol was detected at concentrations (up to 140 ppb) in wells in SWMU-11, and at a much lower concentration (estimated at 0.29 ppb) in hydraulically downgradient well (MW-30S). Irgasan DP-300 was detected in samples from shallow wells in SWMU-11 estimated at concentrations up to 2.3 ppm, and in samples from the SWMU-8 well (MW-13S) at lower concentrations (10 ppb or less). Tinuvin 327, another fingerprint compound, was detected (up to 3 ppb) in samples from a SWMU-8 well (MW-13S) and an AOC-13 well (MW-23S). Various phenols were detected (up to 24 ppb) in samples from the deep overburden well in SWMU-7 (MW-12D)(Table 4-6). Other SVOCs in deep overburden wells were detected in concentrations below 5 ppb. The fingerprint compound Butazolidin was detected in concentrations below 5 ppb.

Benzo(g,h,i)perylene (estimated at 3 ppb) was detected in one of the three samples from the Production Area bedrock well (Table 4-7). No other SVOCs were detected in this well.

4.2.3.3 PCBs - Production Area Groundwater

Aroclor 1260 was detected in two out of three samples from the shallow well in SWMU-7 (MW-12S) at an estimated concentration of 22 ppb and a concentration of 30 ppb (Table 4-5). Aroclor 1248 (1.7 ppb) was detected in one of two samples from the shallow well in AAOI-15 (MW-5S) at the far north end of the Production Area.

PCBs were not detected in the deep overburden wells or the bedrock well in the Production Area.

4.2.3.4 Pesticides - Production Area Groundwater

Organochlorine pesticides were detected sporadically (mostly less than 1 ppb) in some of the shallow overburden wells (Table 4-5). Exceptions were 2.4 ppb of gamma-chlordane in one of the three samples from in SWMU-8 (MW-13S), and an estimated 1.3 ppb of delta-BHC, an estimated 3 ppb of endrin aldehyde, and 1.4 ppb gamma-BHC in SWMU-11 (MW-14S).

Organophosphorous pesticides were detected sporadically (less than 1 ppb) in downgradient shallow wells in AOC-13 (MW-1S and MW-2S), a SWMU-11 well (MW-4S), and a SWMU-8 well (MW-13S).

Organochlorine pesticides were detected sporadically (less than 1 ppb) in deep overburden wells in the Production Area (Table 4-6). None were detected more than once in any well.

Organochlorine and organophosphorous pesticides were detected in samples from the bedrock well (Table 4-7). The maximum concentration of an individual pesticide in these wells was an estimated 0.37 ppb. None of the pesticides were detected more than once in the three sampling events.

4.2.3.5 Herbicides - Production Area Groundwater

The herbicides 2,4,5-TP(Silvex) (up to 0.41 ppb) and 2,4-D (up to 0.8 ppb) were detected in some of the shallow wells in SWMU-11 (Table 4-5). The herbicides 2,4-D (up to 1.4 ppb) and Dinoseb (up to 0.65 ppb) were detected in some of the downgradient shallow wells MW-1S and MW-2S.

No herbicides were detected in the deep overburden wells and bedrock well in the Production Area.

4.2.3.6 Chlorinated Dioxins and Furans - Production Area Groundwater

Phase I groundwater sample analyses for dioxins and furans were rejected because analytical results from the analysis of performance evaluation samples were outside of acceptable ranges established by the USEPA. Additional samples from wells MW-20S, -21S, -22S, -23S, -24S, -29S, -30S, and -31S were analyzed for dioxins and furans in 1992 and none were detected. In the base/neutral fraction analysis, trichlorodibenzofuran was detected in one of the shallow wells (MW-12S) in SWMU-7 (4.4 ppb), and one of the shallow wells (MW-14S) in SWMU-11 (16 and 30 ppb) (Table 4-5).

Total octachlorodibenzodioxin was detected in the sample from deep overburden well MW-31D at a concentration of 0.003 ppb (Table 4-6). No dioxins or furans were detected in SVOC analyses of these samples.

Two of the three samples from the Production Area rock well were analyzed for dioxins and furans. Results for both samples were rejected because of failed performance evaluation samples. No dioxins or furans were detected in base/neutral fraction analyses of these samples.

4.2.3.7 Inorganics - Production Area Groundwater

Concentrations of inorganic analytes detected in Production Area groundwater are presented in Tables 4-8 and 4-9. As described in Section 6.3 only those toxic inorganic analytes frequently occurring in concentrations statistically significantly higher than background soil concentrations are discussed in the following section.

For the Production Area, nickel was the only inorganic analyte determined to meet this criteria.

Total nickel was detected in more than half of the wells in the Production Area. The total nickel concentrations ranged from a minimum of 20.2 ppb to a maximum of 549 ppb (Table 4-8 and Table 4-9). Total nickel was detected in AOC-13 (MW-2S, MW-24S, MW-29S, MW-29D, MW-30D, MW-31S, MW-31D), SWMU-2 (MW-10S, MW-10D), SWMU-7 (MW-12S, MW-12D), SWMU-8 (MW-13S), SWMU-11 (MW-14S, MW-21S), and AAOI-15 (MW-16S). The highest total nickel concentrations were detected in shallow and deep wells along the bulkhead.

Dissolved nickel was detected in four wells in the Production Area. Dissolved nickel concentrations ranged from a minimum of 22.5 ppb to a maximum of 45.2 ppb. Dissolved nickel was detected in overburden wells in AOC-13 (MW-29S, MW-30D), SWMU-2 (MW-10S), and AAOI-15 (MW-16S).

Nickel was not detected in the bedrock well in the Production Area.

4.2.3.8 Non-aqueous Phase Liquids (NAPLs)

During the installation of well MW-34D, southeast of SWMU-11, a non-aqueous phase liquid was encountered. A series of soil borings (B-DT1 through DT-5) were installed to delineate the extent of the liquid. The borings identified the liquid in an area of at least 6,400 square feet at depths from 14 to 30 feet below ground surface within saturated soils. The liquid was identified by a former facility employee as Dowtherm A, and analytical testing confirmed this identification. Dowtherm A is a non-PCB heat transfer fluid composed of phenyl ether and biphenyl ether. The testing also indicated the presence of toluene, chlorobenzene, xylenes, and chlorotoluene. A second liquid was identified in one of the borings (B-DT4), above the Dowtherm A, at a depth of 6 to 10 feet (just above the water table). This was a brown to black liquid tentatively identified in the field as toluene.

Free-phase toluene has been identified in the area of SWMU-11 in vapor extraction well VE-2. Free-phase liquids have not been identified in surrounding wells or borings, suggesting that the toluene is limited to, at most, a 30-ft radius around VE-2. During pilot testing for the soil vapor extraction system, a high pressure vacuum was applied to VE-2. It is likely that this testing caused VE-2 to act as a sump, collecting free-phase toluene from surrounding areas. Once the vacuum was removed, the toluene collected in the well would be trapped. If this is the case, the amount of product currently present in VE-2 is not representative of static conditions in this area.

During recent sampling events, a solvent odor and floating phase have been periodically observed in MW-12S in SWMU-3. Qualitative laboratory analysis indicates that the phase consists of miscellaneous petroleum distillates. Floating phases have not been identified in well MW-13S, located approximately 150 ft hydraulically downgradient from MW-12S.

4.2.3.9 Summary of Production Area Groundwater Contamination

Groundwater contamination is largely limited to shallow groundwater in the process building area. The primary contributors to contamination are toluene, xylenes, ethylbenzene, and chlorobenzene. Groundwater in deeper portions of the overburden contains little contamination. Groundwater in bedrock is essentially free of contaminants.

Elevated levels of total nickel were detected in shallow and deep overburden wells along the bulkhead.

Floating phase product believed to be toluene was identified in the SWMU-11 Area. Free phase Dowtherm A was identified in the central portion of AOC-13. An unidentified floating NAPL was also periodically observed in MW-12S during sampling.

4.2.4 Waste Water Treatment Area Groundwater Contamination

The concentrations of analytes detected in groundwater samples from the WWTA are summarized in Tables 4-11 and 4-12 All of the WWTA groundwater data including detection limits for analytes not detected, are presented in Appendix 4-A.

4.2.4.1 VOCs - WWTA Groundwater

Halogenated and aromatic VOCs were detected in shallow (MW-8S, -9S, and -15S) and deep overburden (MW-15-D) wells (Table 4-11). In all cases, the volatile concentrations were low (30 ppb or less); and in the last sampling event in August 1993, no VOCs were detected in the wells sampled. Trichloroethene (estimated at 2.9 ppb) was detected in one of three samples from the bedrock well. This analyte was not detected in overburden wells.

4.2.4.2 SVOCs - WWTA Groundwater

Samples from two wells (MW-8S and MW-15S) contained detectable levels of SVOCs

(Table 4-11). PAHs were detected (less than 5 ppb) repeatedly in samples from a shallow well located downgradient from SWMU-10 (MW-8S). Dibenzofuran was detected in one of four samples from MW-8S at an estimated concentration of 0.4 ppb (Table 4-11).

Phenols, fingerprint compounds and 1,2-dichlorobenzene were detected repeatedly the shallow well in SWMU-12 (MW-15S) (Table 4-11). Phenols were detected in concentrations up to 67 ppb. Fingerprint compounds including Irgasan DP-300, Butazolidin, Propazine, and Tinuvin 328 were detected in SWUM-12 (MW-15S) at concentrations up to 670 ppb. 1,2-Dichlorobenzene was detected at estimated concentrations of 2 ppb or less.

SVOCs were detected sporadically in the deep overburden and bedrock well. Fingerprint compound Irgasan DP-300 (estimated at 26 ppb) was detected in a deep overburden well (MW-15D). No fingerprint compounds were detected in the bedrock well.

4.2.4.3 PCBs - WWTA Groundwater

PCBs were not detected in groundwater samples.

4.2.4.4 Pesticides - WWTA Groundwater

Organochlorine pesticides were detected (but not more than once) in all but one of the wells (MW-26S) (Table 4-11). The highest concentrations were detected in well MW-15S which contained an estimated 1.6 ppb endrin aldehyde and an estimated 1.2 ppb gamma-chlordane.

4.2.4.5 Herbicides - WWTA Groundwater

Dinoseb was detected in one of three samples from bedrock well RW-2 at an estimated concentration of 0.038 ppb (Table 4-11). No herbicides were detected in the other wells.

4.2.4.6 Chlorinated Dioxins and Furans - WWTA Groundwater

Total trichlorodibenzofuran (an estimated 9.1 ppb) was detected in one of the samples from well MW-15S.

4.2.4.7 Inorganics - WWTA Groundwater

Based on the risk evaluation screening (Section 6.3), none of the inorganics detected in soil samples from the WWTA were detected in significant concentrations. Therefore, there is no source of inorganic contaminants in groundwater in the WWTA. Concentrations of inorganic analytes detected in WWTA groundwater samples are provided in Table 4-12.

4.2.4.8 Summary of WWTA Groundwater Contamination

Low levels of groundwater contaminants were detected in shallow and deep overburden wells. The primary contributors to contamination are halogenated VOCs. Phenols were also detected in shallow wells. Samples from the bedrock well were essentially uncontaminated.

4.2.5 Warwick Area Groundwater Contamination

The concentrations of analytes detected in groundwater samples are summarized in Tables 4-13 through 4-16. All of the Warwick Area groundwater data, including detection limits for analytes not detected, are presented in Appendix 4-A.

4.2.5.1 VOCs - Warwick Area Groundwater

Samples from the well located near the center of SWMU-5 (MW-11S) contained the highest levels of VOCs. The compound detected at the highest concentrations was chlorobenzene (0.39 to 3.5 ppm). Other VOCs detected in this well included benzene and tetrachloroethene.

Samples from the well (MW-6S) located approximately 50 ft upgradient from MW-11S (Figure 2-1) contained low levels of chlorobenzene (less than 2 ppb) in the first two quarters of 1991. In two subsequent sampling events, no VOCs were detected in this well.

VOCs were detected in shallow and deep monitoring wells in the area of SWMU-16 (Table 4-14). 1,1,1-Trichloroethane was detected in three of four samples from a shallow well located in SWMU-16 (MW-17S); and in the only sample collected from the shallow well located downgradient from SWMU-16 (MW-32S). The concentrations in samples from MW-17S decreased by an order of magnitude (34 ppb to an estimated 2.9 ppb) between January and September 1991, and were not detected in 1993. 1,1-Dichloroethane (estimated at 4.1 ppb) was only detected in the first sample from MW-17S. Trichloroethene was detected in the first two out of four

samples from MW-17S (estimated at 2.1 and 1.3 ppb). Toluene (estimated at 2 ppb) was detected in one out of three samples from MW-17D.

No VOCs were detected in samples from the shallow monitoring well (MW-26S) located downgradient from SWMU-5, or the deep overburden well (MW-11D) and bedrock well (RW-3) in SWMU-5.

4.2.5.2 SVOCs - Warwick Area Groundwater

SVOCs were detected in shallow monitoring wells and the rock well installed in the vicinity of SWMU-5 (Figure 2-1). The largest number of compounds were detected in monitoring well MW-11S, including phenols, anilines, phthalates, PAHs and fingerprint compounds (Table 4-13). Approximately half of the SVOCs detected in the initial sampling of this well were not detected in the last sampling event.

Diethylphthalate and the fingerprint compounds Propazine and Tinuvin 327 were detected in samples from MW-6S. In the most recent sampling event, no SVOCs were detected in the sample from this well.

Di-n-octylphthalate, pyrene and fluoranthene were detected in the bedrock well (RW-3) in SWMU-5. Pyrene and fluoranthene were not detected in overburden wells.

Di-n-butylphthalate was detected in one of the samples from in SWMU-16 (MW-17D).

No SVOCs were detected in wells downgradient of SWMUs (MW-26S and MW-32S), or the deep overburden well in SWMU-5.

Fingerprint compounds Propazine (up to 35 ppb) and Tinuvin 327 (up to 4 ppb) were detected in the SWMU-5 Area (MW-6S and MW-11S).

4.2.5.3 PCBs - Warwick Area Groundwater

PCBs were not detected in groundwater samples from the Warwick Area.

4.2.5.4 Pesticides - Warwick Area Groundwater

Organochlorine pesticides were detected (less than 0.09 ppb) in all of the wells in SWMU-5 (Table 4-13). None of the organochlorine pesticides were detected more than once in any given well. Dimethoate was detected in one of the four samples

collected from well MW-6S at an estimated concentration of 0.44 ppb.

Organochlorine pesticides were detected (less than 0.025 ppb) in one of the three samples collected from the deep overburden well MW-17D in SWMU-16 (Table 4-14). No other groundwater samples from SWMU-16 contained detectable levels of pesticides.

4.2.5.5 Herbicides - Warwick Area Groundwater

2,4-T and Dinoseb were detected in well MW-11S at estimated concentrations of 0.11 and 0.04 ppb, respectively (Table 4-13).

No herbicides were detected in wells in SWMU-16.

4.2.5.6 Chlorinated Dioxins and Furans - Warwick Area Groundwater

Total octachlorodibenzodioxin (estimated at 0.0012 ppb) was detected in one sample from a shallow well (MW-6S) in SWMU-5 (Table 4-13).

No dioxins or furans were detected in wells in SWMU-16.

4.2.5.7 Inorganics - Warwick Area Groundwater

Concentrations of inorganic analytes detected in Warwick Area groundwater are presented in Tables 4-15 and 4-16. As described in Section 6.3, only those toxic inorganic analytes occurring frequently in concentrations statistically significantly higher than background soil concentrations are discussed in the following section. For the Warwick Area, beryllium, cadmium, chromium, zinc and antimony were the only inorganic analytes determined to meet these criteria.

Total and dissolved beryllium, cadmium, chromium, and zinc were detected in SWMU-5. Total and dissolved zinc and total chromium were detected in SWMU-16.

Total beryllium was detected in 4 out of a total of 26 samples at concentrations ranging from a minimum of 2.4 ppb to a maximum of 21 ppb (Table 4-15 and Table 4-16). Total beryllium was detected in SWMU-5 (MW-6S, MW-11S, MW-26S). Total cadmium was detected in 2 out of a total of 26 samples at concentrations ranging from a minimum of 8 ppb to a maximum of 17.8 ppb. Total cadmium was detected in SWMU-5 (MW-11S and MW-26S). Total chromium was detected in 18 out of 26 samples at concentrations ranging from 10.8 ppb to 62.3 ppb. Total chromium was detected in SWMU-5 (RW-3, MW-6S, MW11-S, MW-11D, and MW-

26S) and in SWMU-16 (MW-17D, MW-17S, and MW-32S). Total zinc was detected in 20 out of a total of 26 samples at concentrations ranging from a minimum of 31 ppb to a maximum of 2,160 ppb. Total zinc was detected in SWMU-5 (MW-6S, MW11-S, MW-11D, and MW-26S) and in SWMU-16 (MW-17D, MW-17S and MW-32S).

Dissolved beryllium was detected in 1 out of a total of 26 samples at a concentration of 3.5 ppm (Table 4-15 and Table 4-16). Dissolved beryllium was detected in SWMU-5 (MW-11S). Dissolved cadmium was detected in 2 out of a total of 26 samples at concentrations ranging from a minimum of 11.6 ppb to a maximum of 17 ppb. Dissolved cadmium was detected in SWMU-5 (RW-3 and MW-11S). Dissolved chromium was detected in 1 out of 26 samples at a concentration of 12.3 ppb. Dissolved chromium was detected in SWMU-5 (MW-11S). Dissolved zinc was detected in 12 out of a total of 26 samples at concentrations ranging from a minimum of 31 ppb to a maximum of 1530 ppb. Dissolved zinc was detected in SWMU-5 (MW-6S, MW11-S, and MW-26S) and in SWMU-16 (MW-32S).

4.2.5.8 Summary of Warwick Area Groundwater Contamination

VOCs and SVOCs appear to be limited to the shallow groundwater beneath SWMU-5, and their concentrations are generally low. SVOCs are also present in the bedrock aquifer beneath SWMU-5. The specific SVOCs detected in the shallow groundwater are not the same as those detected in the bedrock aquifer suggesting that there is no relation between sources of contaminants in the overburden aquifer and the bedrock aquifer.

Low levels (less than 35 ppb) of 1,1,1-trichloroethane were detected in shallow groundwater in the area of SWMU-16. 1,1,1-Trichloroethane concentrations decreased by an order of magnitude between January and September 1991, and was not detectable in 1993.

Elevated levels of total and dissolved beryllium, cadmium, chromium and zinc were detected in SWMU-5. Elevated levels of total and dissolved zinc and total chromium were detected in SWMU-16.

4.3 SOIL CONTAMINATION

This section presents the results of the soil contamination characterization. Soil sampling methods and analyses are discussed first. The rest of this section is presented as follows:

- soil sampling;

- Background soil contamination;
- Production Area soil contamination;
- Waste Water Treatment Area soil contamination; and
- Warwick Area soil contamination.

4.3.1 Soil Sampling

Both surface and subsurface soil samples were collected in accordance with the procedures specified in the QAPP - Supplement dated January 1992. These samples were submitted to the laboratory and analyzed for Appendix IX compounds and Fingerprint compounds. Table 4-17 summarizes the Phase II soil sampling program. Soil was sampled from the four areas presented below:

Background
Soils were sampled at both "background" and "off-site" locations during the RFI. Figure 4-5 shows the "background" sampling locations.

Production Area
Soils in the Production Area were sampled at the following locations (Figure 4-6A):

- the process building area (AOC-13) - where most of the manufacturing took place and where buildings were demolished;
- SWMUs -2, -3, -7, -8, and -11 (physically located within AOC-13); and
- a former sump identified by Ciba as an area of additional investigation (AAOI-15).

WWTA
Soils in the WWTA were sampled at surface and depth at the following locations (Figure 4-6B):

- the entire Waste Water Treatment Plant area (SWMU-12); and
- the site of a waste water release (SWMU-10).

Warwick Area
Soils in the Warwick Area were sampled at the following locations (Figure 4-6C):

- the former dredged sediment storage area (SWMU-5);
- the zinc oxide pile (SWMU-6);
- the site of a waste water pipeline break (SWMU-9);
- the site of the former maintenance area sump (SWMU-16); and
- near piezometers P-21S and P-21D where odorous soils were encountered during drilling.

4.3.2 Background and Off-Site Soil Contamination

The sample data described in the following sections includes both "background" and "off-site" samples. These data sets were combined because statistical test show that analytes detected in samples from "off-site" locations were similar in both type and concentration to those detected in background samples. (See statistical test results in Appendix 4-B.) The distinction between these two sets of data was originally made in the Order. The Order requires that off-site locations potentially impacted by Ciba activities be sampled, and that locations representative of local, unimpacted (background) soil conditions be sampled.

4.3.2.1 VOCs - Background/Off-site Soil

Shallow soil (0-2 ft) - Toluene (up to 1.2 ppm) was detected in about half of the shallow background soil samples (Table 4-18). Other volatiles were less frequently detected, at concentrations less than 1 ppm.

Deep soil (greater than 2 ft) - Methylene chloride (up to 14 ppb) was detected in two of the four deep background soil samples (Table 4-19). Chloroform (6.9 ppb) was detected in one sample.

4.3.2.2 SVOCs - Background/Off-site Soil

Shallow soil (0-2 ft) - PAHs were detected in all of the shallow background soil samples (Table 4-18) and ranged from less than one to 69 ppm. The majority were below 10 ppm. Dibenzofuran (up to an estimated 9.7 ppm) was detected in 13 of the 43 shallow background soil samples (Table 4-18). Other SVOCs were detected, but at much lower frequencies. Fingerprint compounds were not detected in shallow background soil samples.

Deep soil (greater than 2 ft) - Fluoranthene and pyrene (0.2 ppm or less) were the only SVOCs detected in more than one deep background soil sample (Table 4-19). Fingerprint compounds were not detected in deep background soil samples.

4.3.2.3 PCBs - Background/Off-site Soil

Shallow soil (0-2 ft) - Aroclor 1254 was detected in one shallow background soil sample (from Cranston General Hospital) at a concentration of 0.16 ppm (Table 4-18).

Deep soil (greater than 2 ft) - PCBs were not detected in deep background soils.

4.3.2.4 Pesticides - Background/Off-site Soil

Shallow soil (0-2 ft) - 4,4'-DDE, and 4,4'-DDT were detected in more than half of the shallow background soil samples (Table 4-18). Most concentrations of these analytes were below 1 ppm. A notable exception was 4,4'-DDT detected in one sample at 9.3 ppm.

Deep soil (greater than 2 ft) - Methoxychlor (34 and 830 ppb) was detected in two of the four background soil samples (Table 4-19).

4.3.2.5 Herbicides - Background/Off-site Soil

Shallow soil (0-2 ft) - 2,4,5 T (up to an estimated 2.3 ppb) was detected in two shallow background soil samples (Table 4-18). Other herbicides were detected, but not more than once in any sample.

Deep soil (greater than 2 ft) - No herbicides were detected in deep background soil samples.

4.3.2.6 Chlorinated Dioxins and Furans - Background/Off-site Soil

Shallow soil (0-2 ft) - Octachlorodibenzodioxin (up to an estimated 1.2 ppb) was detected in ten out of twenty-one shallow soil samples (Table 4-18). Other chlorinated dioxins and furans were detected, but not more than once in any sample.

Deep soil (greater than 2 ft) - One of the four deep background soil samples contained detectable levels of chlorinated dioxins (octa- and hepta-) at estimated concentrations up to an estimated 1.3 ppb (Table 4-19).

4.3.2.7 Inorganics - Background/Off-site Soil

Inorganic data for background/off-site soil are summarized in Tables 4-20 and 4-21. Nearly all of the inorganic analytes for which these samples were analyzed were detected. Because inorganic analytes occur naturally in nature, their presence does not necessarily indicate contamination.

4.3.2.8 Summary of Background/Off-site Soil Contamination

Contaminants detected in background/off-site soil samples are typical of urban locations. All of the samples contained PAHs which are components of petroleum

products such as fuels and lubricants, products of combustion, and occur naturally. Many of the samples contained toluene which is also a component of fuels. Low levels of pesticides, herbicides, chlorinated dioxins, and metals were also detected in background/off-site soil samples.

4.3.3 Production Area Soil Contamination

The concentrations of analytes detected in soil samples from the Production Area are summarized in Tables 4-22 through 4-25. All of the Production Area soil data including detection limits for analytes not detected, are presented in Appendix 4-C.

4.3.3.1 VOCs - Production Area Soil

Shallow soil (0-2 ft) - Xylenes and toluene were detected in the process building area (Table 4-22). The highest concentrations of these analytes were detected in a sample from SWMU-8. This sample contained up to 400 ppm xylenes, and 4.6 ppm toluene. Average concentrations for these analytes in other samples were much lower.

Deep soil (greater than 2 ft) - Ethylbenzene, xylenes and toluene were detected in the process building area (Table 4-23). On average, xylenes were detected at concentrations below 20 ppm. Higher concentrations (up to 120 ppm) were detected in SWMU-11. Toluene was generally detected at concentrations below 1 ppm. Higher concentrations (up to 1,200 ppm) were detected in SWMU-11. On average, ethylbenzene was detected at concentrations less than 6 ppm. Higher concentrations (up to 29 ppm) were detected in samples from SWMU-11.

4.3.3.2 SVOCs - Production Area Soil

Shallow soil (0-2 ft) - PAHs were detected in the Production Area (Table 4-22). All of the concentrations were below 8.5 ppm. Other SVOCs were detected sporadically, and at low concentrations (mostly less than 1 ppm). The fingerprint compounds Irgasan DP-300, Tinuvin 327, and Tinuvin 328 were detected at concentrations less than 6 ppm.

Deep soil (greater than 2 ft) - PAHs were detected in the Production Area (Table 4-23). The maximum concentration of any one PAH detected was 2.2 ppm. 3 & 4 Methyl phenol were also detected in many samples, at a maximum concentration of 1.2 ppm. The fingerprint compounds Propazine and Tinuvin 327 were detected at concentrations less than 40 ppm.

4.3.3.3 PCBs - Production Area Soil

Shallow soil (0-2 ft) - Aroclors 1248, 1254, and 1260 were detected in the building demolition section of the Production Area (Table 4-22). Concentrations ranged from less than 1 ppm to 4,500 ppm. Most of the concentrations were below 10 ppm. The highest levels of PCBs were found near the south end of the process building area (Figure 4-7).

Deep soil (greater than 2 ft) - Aroclors 1254 and 1260 were detected in the process building area (Table 4-23) (Figure 4-8). Concentrations ranged from 0.054 ppm to an estimated 13 ppm. Most concentrations were below 5 ppm.

4.3.3.4 Pesticides - Production Area Soil

Shallow soil (0-2 ft) - Pesticides were detected sporadically and at low concentrations (less than 1 ppm on average) in the Production Area (Table 4-22).

Deep soil (greater than 2 ft) - Pesticides were detected sporadically and at low concentrations (less than 1 ppm on average) in the Production Area (Table 4-23).

4.3.3.5 Herbicides - Production Area Soil

Shallow soil (0-2 ft) - Herbicides were detected sporadically at low concentrations (less than 0.01 ppm) in the process building area (Table 4-22). No herbicides were detected in samples from AAOI-15.

Deep soil (greater than 2 ft) - Herbicides were detected sporadically at low concentrations (less than 0.11 ppm) in the process building area (Table 4-23). No herbicides were detected in samples from AAOI-15.

4.3.3.6 Dioxins and Furans - Production Area Soil

Shallow soil (0-2 ft) - Soil samples from the Production Area collected during Phase I were analyzed for the Appendix IX list of dioxins and furans, but the analyses were rejected because of failed performance evaluation analyses. Selected Phase II samples were analyzed for an expanded list of dioxins and furans. Total trichlorodibenzofuran (up to an estimated 3.9 ppm), total tetrachlorodibenzofuran (up to 0.19 ppb) and total octachlorodibenzofuran (up to 0.46 ppb) were detected in the process building area (Table 4-22). 1,2,3,4,6,7,8-Heptachlorodibenzodioxin, total heptachlorodibenzodioxin, and total octachlorodibenzodioxin were detected in AAOI-15. Concentrations of each of these analytes was below 0.78 ppb.

Deep soil (greater than 2 ft) - Total tetrachlorodibenzofuran was detected in one of the four deep soil samples from the process building area (Table 4-23). The estimated maximum concentration for this analyte was 0.056 ppb. Total trichlorodibenzofuran was detected in approximately half of the samples; the maximum concentration detected was 270 ppm. The highest concentrations occurred in samples from SWMU-11. No dioxins or furans were detected in AAOI-15.

4.3.3.7 Inorganics - Production Area Soil

Concentrations of inorganic analytes detected in Production Area soil are presented in Tables 4-24 and 4-25. As described in Section 6.3, only those toxic inorganic analytes occurring frequently in concentrations statistically significantly higher than background soil concentrations are discussed in the following section. For the Production Area, nickel was the only inorganic analyte determined to meet these criteria.

Shallow soil (0-2 ft) - Nickel was detected in 31 out of a total of 35 samples at concentration ranging from a minimum of 1.5 ppm to a maximum of 26.6 ppm (Table 4-24). Nickel was detected in all of the Production Area SWMUs, AOC-13, and AAOI-15. The highest concentrations were detected along the west side of AOC-13, near Mill Street.

Deep soil (greater than 2 ft) - Nickel was detected in 23 out of a total of 26 samples at concentrations ranging from a minimum of 0.63 ppm to a maximum of 21 ppm (Table 4-25). Nickel was detected in SWMU-2, SWMU-3, SWMU-7, SWMU-8, SWMU-11, AOC-13, and AAOI-15. The highest concentrations were detected in SWMU-2 and SWMU-8.

4.3.3.8 Soil Gas - Production Area

A copy of the Shallow Soil Gas Investigation report prepared by Tracer Research Corporation is included in Appendix 4-D. The results of the investigation are summarized below.

Toluene was detected in 24 out of 101 soil gas sampling locations in the Production Area at depths up to four feet below ground surface. All of these detections were in the area of SWMU-11 (except for one sampling location between SWMU-7 and -8). The highest concentration of toluene detected was 18 ppm.

Chlorobenzene was detected in 5 out of 101 samples in concentrations up to 80 ppb. The highest concentrations were detected in the area of SWMU-11.

Ethylbenzene was detected in 3 out of 101 samples in concentrations below 1 ppb.

Total xylenes were detected in 20 out of 101 samples in concentrations up to 470 ppb. Most of the detections, and the highest concentrations were found in the area of SWMU-11. Other detections were in the areas of SWMUs-7 and -8, and along the river near the pedestrian bridge.

4.3.3.9 Summary of Production Area Soil Contamination

Shallow soil contamination in the Production Area is largely limited to PCBs, xylenes, and toluene in the process building area. The highest concentrations of PCBs were found near the southern end of the process building area. The highest concentrations of VOCs in shallow soil samples were in the area of SWMU-8. Deep soil in the process building area contained ethylbenzene, xylenes and toluene. The highest concentrations of VOCs in deep soil samples were detected in the area of SWMU-11.

Toluene, chlorobenzene, ethylbenzene and xylenes were detected in soil gas samples from the process building area. The highest concentrations were detected in the area of SWMU-11. There are good correlations between high concentrations of toluene in soil samples from the area of SWMU-11 with high concentrations of toluene in soil gas results as well as between detections of high concentrations of total xylenes in soil samples from SWMUs -3, -7, -8, and -11 with high concentrations of xylenes in soil gas results. However, chlorobenzene in soil samples versus chlorobenzene in soil gas did not correlate well.

Elevated concentrations of nickel were detected in shallow soils, especially along Mill Street in AOC-13. Elevated concentrations of nickel were detected in deep soils, especially in SWMU-2 and SWMU-8.

4.3.4 WWTA Soil Contamination

The concentrations of analytes detected in soil samples from the WWTA are summarized in Tables 4-26 and 4-27. All of the WWTA soil data including detection limits, are presented in Appendix 4-C.

4.3.4.1 VOCs - WWTA Soil

Shallow (0-2 ft) - Toluene, m & p xylene, and chlorobenzene were detected in about half of the shallow soil samples in SWMU-12 (Table 4-26). The highest concentration detected was an estimated 13 ppm of chlorobenzene. Other volatiles were detected, but at a lower frequency.

Deep (greater than 2 ft) - Low levels (less than 0.25 ppm) of VOCs were detected in nearly all the SWMU-12 deep soil samples, and one of the six SWMU-10 samples (Table 4-27).

4.3.4.2 SVOCs - WWTA Soil

Shallow (0-2 ft) - PAHs were detected in from the WWTA (Table 4-26). The highest concentration of any PAH in these samples was 6.9 ppm. 2,4 Dichlorophenol was detected in about half the samples in estimated concentrations ranging from 0.13 to 2.1 ppm. Other SVOCs were detected, but at much lower frequencies. Fingerprint compounds Irgasan DP-300 (340 ppm), Propazine (28 ppm), Tinuvin 327 (26 ppm), and Tinuvin 328 (210 ppm) were detected.

Deep (greater than 2 ft) - PAHs were detected in SWMU-12 deep soil samples at concentrations of 2.1 ppm or less (Table 4-27). 4-Chloroaniline was detected in all the SWMU-12 samples at concentrations of 0.86 ppm or less. Other semi-volatile analytes were detected less frequently and, except for fingerprint compounds, at concentrations below 1 ppm. Fingerprint compounds Irgasan DP-300 (67 ppm) and Tinuvin 328 (140 ppm) were detected in one soil sample from SWMU-12.

4.3.4.3 PCBs - WWTA Soil

Shallow (0-2 ft) - Aroclor 1254 was detected in one sample from the WWTA at a concentration of 0.21 ppm (Table 4-26).

Deep (greater than 2 ft) - Aroclor 1254 was detected in one sample from SWMU-10 at a concentration of 0.057 ppm (Table 4-27).

4.3.4.4 Pesticides - WWTA Soil

Shallow (0-2 ft) - Gamma chlordane (up to 19 ppm) was detected in 8 of the 21 shallow soil samples from the WWTA (Table 4-26). Other pesticides were also detected, but less frequently and at concentrations below 1 ppm.

Deep (greater than 2 ft) - Gamma chlordane was detected in all of the SWMU-12 samples at concentrations up to an estimated 2.1 ppm (Table 4-27). Other pesticides were detected sporadically.

4.3.4.5 Herbicides - WWTA Soil

Shallow (0-2 ft) - Herbicides were detected in only 5 of the 21 shallow soil samples from the WWTA (Table 4-26). The maximum concentration detected was an estimated 0.12 ppm of 2,4-D.

Deep (greater than 2 ft) - 2,4-D (0.055 ppm) was detected in one SWMU-12 deep soil sample analyzed for herbicides (Table 4-27). No herbicides were detected in SWMU-10 deep soil samples.

4.3.4.6 Chlorinated Dioxins and Furans - WWTA Soil

Shallow (0-2 ft) - 2,3,7,8-Tetrachlorodibenzofuran and total tetrachlorodibenzofuran in concentrations (up to 8.9 ppb) were detected in two of the six Phase II shallow soil samples (Table 4-26). Total trichlorodibenzofuran (0.58 to 120 ppm) was detected in nine of ten shallow soil samples (Table 4-26). Most concentrations were below 30 ppm. Total dichlorodibenzofuran was detected in three of ten samples at concentrations ranging from 0.2 to 7.2 ppm.

Deep (greater than 2 ft) - One deep Phase II soil sample was analyzed for dioxins and furans. This sample contained 2,3,7,8-tetrachlorodibenzofuran (estimated at 0.1 ppb) and total tetrachlorodibenzofuran (2.3 ppb) (Table 4-27).

4.3.4.7 Inorganics - WWTA Soil

Concentrations of inorganic analytes detected in WWTA soil samples are presented in Tables 4-28 and 4-29. Based on the risk evaluation screening (Section 6.3), none of the inorganics detected in soil samples from the WWTA were detected in significant concentrations.

4.3.4.8 Soil Gas - WWTA

A copy of the Shallow Soil Gas Investigation report prepared by Tracer Research Corporation is included in Appendix 4-D. The results of the investigation are summarized below.

Toluene was detected in two soil gas samples from the area of the former trickling towers at a maximum concentration of 0.9 ppb. Soil gas samples were collected at depths up to 2.5 feet below ground surface.

Chlorobenzene (0.4 ppb), ethylbenzene (0.8 ppb), and total xylenes (2 ppb) were

detected in one sample. The samples in which these analytes were detected were the same ones which contained toluene.

4.3.4.9 Summary of WWTA Soil Contamination

VOCs, SVOCs, and tetrachlorodibenzofuran were detected in nearly all of the WWTA soil samples. Toluene, m- & p-xylene, and chlorobenzene were detected in concentrations of 13 ppm or less. SVOCs were detected in concentrations below 10 ppm. Fingerprint compounds were detected in concentrations up to 340 ppm. Tetrachlorodibenzofuran was detected in concentrations up to 8.9 ppb.

4.3.5 Warwick Area Soil Contamination

The concentrations of analytes detected in soil samples from the Warwick Area are summarized in Tables 4-30 through 4-34. All of the Warwick Area soil data including detection limits, are presented in Appendix 4-C.

4.3.5.1 VOCs - Warwick Area Soil

Shallow (0-2 ft) - VOCs were not detected in SWMU-6 (the zinc oxide/soil pile). VOCs were detected in SWMU-16 and SWMU-9 at concentrations of 0.05 ppm or less (Table 4-31). Chlorobenzene, m- & p-xylene, tetrachloroethene, and toluene were detected in many of the shallow soil samples from SWMU-5 (Table 4-30) at low concentrations (less than 4 ppm). Other volatiles were also detected in SWMU-5 samples, but not as frequently.

No VOCs were detected in samples collected from the area of piezometers P-21S and P-21D.

Deep (greater than 2 ft) - VOCs were detected at concentrations of 11 ppm or less in deep soil samples from the Warwick Area with two exceptions. One sample from SWMU-5 contained 510 ppm chlorobenzene, and 100 ppm toluene (Table 4-32).

4.3.5.2 SVOCs - Warwick Area Soil

Shallow (0-2 ft) - Nearly all of the shallow soil samples from SWMU-5 contained detectable levels of PAHs (Table 4-30) at concentrations below 4 ppm. All but one of the samples from other parts of the Warwick Area contained non-detect levels of PAHs (Table 4-31). Fingerprint compounds Propazine and Tinuvin 327 were detected at concentrations less than 25 ppm at SWMU-5 and Tinuvin 327 was

detected at concentrations less than 10 ppm in SWMU-6 and SWMU-9.

Approximately half of the shallow soil samples from SWMU-5 contained detectable levels of bis(2-ethylhexyl)phthalate (up to 140 ppm), and 4-chloraniline (up to an estimated 7.4 ppm). Other SVOCs were detected much less frequently.

Deep (greater than 2 ft) - Most deep soil samples analyzed for semi-volatiles contained detectable levels of PAHs. Nearly all concentrations were below 2 ppm (Table 4-32). Most of the deep soil samples from SWMU-5 contained bis(2-ethylhexyl)phthalate (up to an estimated 160 ppm). Other SVOCs were also detected, but not as frequently. Tinuvin 327, a fingerprint compound, was detected (0.55 ppm) at SWMU-9.

4.3.5.3 PCBs - Warwick Area Soil

Shallow (0-2 ft) - Aroclors 1248 and 1254 were detected in SWMU-5 at concentrations up to an estimated 160 ppm (Table 4-30) (Figures 4-9 and 4-10). All but one concentration were below 50 ppm. Samples from SWMUs -6, -9, and -16 contained less than 1 ppm of Aroclor 1254 (Table 4-31).

Deep (greater than 2 ft) - One deep soil sample from SWMU-5 (Figure 4-11) and one from SWMU-16 contained less than 0.2 ppm Aroclor 1254 (Table 4-32).

4.3.5.4 Pesticides - Warwick Area Soil

Shallow (0-2 ft) - Methoxychlor was detected in about half of the shallow soil samples from SWMU-5 and (Table 4-30). Concentrations of methoxychlor in these samples ranged from 0.092 to 2,200 ppm. Other pesticides were detected in samples from SWMU-5, and other areas but at lower levels and less frequently (Table 4-31).

Deep (greater than 2 ft) - Methoxychlor was detected in SWMU-9, and SWMU-5 (Table 4-32). Most concentrations were below 2 ppm, but two samples from SWMU-5 were much higher (160 and 1,800 ppm). Other pesticides were detected sporadically at concentrations below 0.05 ppm.

4.3.5.5 Herbicides - Warwick Area Soil

Shallow (0-2 ft) - Herbicides were detected in four of the nineteen shallow soil samples from SWMU-5 (Table 4-30) at concentrations of 0.35 ppm or less. Samples from other parts of the other Area did not contain detectable levels of herbicides.

Deep (greater than 2 ft) - No herbicides were detected in deep soil samples.

4.3.5.6 Chlorinated Dioxins and Furans - Warwick Area Soil

Shallow (0-2 ft) - Phase I soil sample analyses for dioxins and furans were rejected because analytical results from the analysis of performance evaluation samples were outside of acceptable ranges established by the USEPA. One Phase II shallow soil sample from SWMU-5 was analyzed for dioxins and furans and none were detected.

Deep (greater than 2 ft) - Total octachlorodibenzodioxin was detected in deep soil samples from SWMU-5 and SWMU-9 (Table 4-32). Both of the concentrations were below 0.004 ppm.

4.3.5.7 Inorganics - Warwick Area Soil

Concentrations of inorganic analytes detected in Warwick Area soil are presented in Tables 4-33 and 4-34. As described in Section 6.3 only those toxic inorganic analytes frequently occurring in concentrations statistically significantly higher than background soil concentrations are discussed in the following section. For the Warwick Area, beryllium, cadmium, chromium, zinc and antimony were the only inorganic analytes determined to meet these criteria.

Shallow (0-2 ft) - Beryllium was detected in 31 out of a total of 31 samples at concentrations ranging from a minimum of 7.3 ppm to a maximum of 1,270 ppm (Table 4-33). Beryllium was detected in SWMU-5, SWMU-6, SWMU-9, and SWMU-16. The highest beryllium concentrations were detected in SWMU-5. Cadmium was detected in 15 out of a total of 31 samples at concentrations ranging from a minimum of 0.28 ppm to a maximum of 6.9 ppm. Cadmium was detected in SWMU-5 and in SWMU-6. The highest cadmium concentrations were detected in SWMU-5. Chromium was detected in 31 out of 31 samples at concentrations ranging from 1.3 ppm to 357 ppm. Chromium was detected in SWMU-5, SWMU-6, SWMU-9, and SWMU-16. The highest chromium concentrations were detected in SWMU-5. Zinc was detected in 28 out of a total of 31 samples at concentrations ranging from a minimum of 24.8 ppm to a maximum of 16,100 ppm. Zinc was detected in SWMU-5, SWMU-6, SWMU-9, and SWMU-16. The highest zinc concentrations were detected in SWMU-5. Antimony was detected in 6 out of a total of 23 samples (antimony data was rejected in 8 samples) at concentrations ranging from 0.86 to 418 ppm. Antimony was only detected in SWMU-5.

Deep (greater than 2 ft) - Beryllium was detected in 12 out of a total of 13 samples at concentrations ranging from a minimum of 0.23 ppm to a maximum of 1.5 ppm (Table 4-34). Beryllium was detected in SWMU-5, SWMU-9, and SWMU-16. The

highest beryllium concentrations were detected in SWMU-5. Cadmium was detected in 2 out of a total of 13 samples at concentrations ranging from a minimum of 2 ppm to a maximum of 7.6 ppm. Cadmium was only detected in SWMU-5. Chromium was detected in 13 out of 13 samples at concentrations ranging from 2.5 ppm to 478 ppm. Chromium was detected in SWMU-5, SWMU-9, and SWMU-16. The highest concentrations of chromium were detected in SWMU-5. Zinc was detected in 13 out of a total of 13 samples at concentrations ranging from a minimum of 18.3 ppm to a maximum of 7,300 ppm. Zinc was detected in SWMU-5, SWMU-9, and SWMU-16. The highest zinc concentrations were detected in SWMU-5. Antimony was detected in 1 out of a total of 7 samples (from SWMU-5 and SWMU-16 only) at a concentration of 2.3 ppm. Antimony was only detected in SWMU-5.

4.3.5.8 Soil Gas - Warwick Area

A copy of the Shallow Soil Gas Investigation report prepared by Tracer Research Corporation is included in Appendix 4-D. The results of the investigation are summarized below.

Soil gas samples were collected at depths up to 2.5 feet below ground surface in the Warwick Area. One of the 18 soil gas samples from the area of SWMU-5 contained detectable levels of volatiles. This sample, near MW-11S, contained 2 ppb toluene, 5 ppb chlorobenzene, and 22 ppb total xylenes.

All but one of the 17 soil gas samples from the area of SWMU-16 contained detectable levels of 1,1,1-trichloroethane. Concentrations ranged from 0.1 to 540 ppb. The highest concentrations were centered around the area of wells MW-17S and MW-17D. Three of the four ambient air samples collected in the SWMU-16 area during the soil gas sampling event contained detectable levels of 1,1,1-trichloroethane (0.001 to 0.004 ppb).

4.3.5.9 Summary of Warwick Area Soil Contamination

Contaminated soil in the Warwick Area is largely confined to soils in SWMU-5. Methoxychlor and PCBs were prevalent at relatively high concentrations in SWMU-5 shallow soil samples. One deep soil sample from SWMU-5 contained elevated levels of chlorobenzene and toluene. Bis(2-ethylhexyl)phthalate was detected in elevated concentrations in both shallow and deep soil samples.

Elevated levels of beryllium, cadmium, chromium, zinc and antimony were detected in Warwick Area soils. The highest concentrations of these analytes were detected in SWMU-5.

Soil gas in the area of SWMU-16 contained 1,1,1-trichloroethane.

4.4 ON-SITE SURFACE WATER CONTAMINATION

This section presents the on-site surface water contamination characterization for the wetland area located in the Waste Water Treatment Area. The sampling methods and analyses are presented first, followed by a discussion of the results. Surface water analytical data are presented in Appendix 4-E.

4.4.1 On-site Surface Water Sampling

Surface water was sampled from the wetland area during the RFI. Samples were collected in accordance with the procedures specified in the QAPP- Supplement dated January 1992. These samples were submitted to the laboratory and analyzed for Appendix IX compounds.

4.4.2 On-Site Surface Water Contamination

4.4.2.1 VOCs - On-Site Surface Water

2-Hexanone (estimated at 7 ppb) was detected in one of two surface water samples collected from the wetland area (Table 4-35). No other VOCs were detected in these samples.

4.4.2.2 SVOCs - On-Site Surface Water

SVOCs were not detected in surface water samples from the wetland area. No fingerprint compounds were detected in on-site surface water.

4.4.2.3 PCBs - On-Site Surface Water

PCBs were not detected in surface water samples from the wetland area.

4.4.2.4 Pesticides - On-Site Surface Water

Three organochlorine pesticides were detected in surface water samples from the wetland area. All concentrations were below 80 ppb (Table 4-35). None of the pesticides were detected more than once.

4.4.2.5 Herbicides - On-Site Surface Water

Herbicides were not detected in surface water samples from the wetland area.

4.4.2.6 Chlorinated Dioxins and Furans - On-Site Surface Water

Chlorinated dioxins and furans were not detected in surface water samples from the wetland area.

4.4.2.7 Inorganics - On-Site Surface Water

Concentrations of inorganic analytes detected in surface water samples were generally within the same order of magnitude as upstream Pawtuxet River water samples (Table 4-36).

4.4.3 Summary of On-Site Surface Water Contamination

Surface water in the WWTA wetland area is essentially uncontaminated.

4.5 ON-SITE SEDIMENT CONTAMINATION

This section presents the on-site sediment contamination characterization for the wetland located in the WWTA. The sediment sampling methods and analyses are presented first, followed by a discussion of the results.

4.5.1 On-site Sediment Sampling

Sediment was sampled from the wetlands in the WWTA during the RFI. Samples were collected in accordance with the procedures specified in the QAPP-Supplement. These samples were submitted to the laboratory and analyzed for Appendix IX compounds. Appendix 4-F presents the analytical results for the sediment sampling.

4.5.2 On-Site Sediment Contamination

4.5.2.1 VOCs - On-Site Sediment

Two of the five WWTA sediment samples contained detectable levels of VOCs. Each of these volatiles was detected in concentrations of 0.15 ppm or less (Table 4-37).

4.5.2.2 SVOCs - On-Site Sediment

All of the WWTA sediment samples contained detectable levels of PAHs at concentrations of 5.6 ppm or less (Table 4-37).

Bis(2-ethylhexyl)phthalate was detected in four out of five sediment samples at

estimated concentrations of 1.1 ppm or less.

No fingerprint compound were detected in on-site sediment samples.

4.5.2.3 PCBs - On-Site Sediment

PCBs were not detected in sediment samples from the WWTA.

4.5.2.4 Pesticides - On-Site Sediment

Organochlorine pesticides were detected in four of the five sediment samples from the WWTA at concentrations estimated at 57 ppb or less (Table 4-37).

4.5.2.5 Herbicides - On-Site Sediment

Herbicides were not detected in sediment samples from the WWTA.

4.5.2.6 Chlorinated Dioxins and Furans - On-Site Sediment

Total Di- and trichlorodibenzofurans were detected in sediment samples at concentrations of 5.8 ppm or less (Table 4-37). 2,3,7,8 Tetrachlorodibenzofuran was detected at a maximum estimated concentration of 0.046 ppb. Total tetrachlorodibenzofuran was detected at a maximum estimated concentration of 0.42 ppb. Total octachlodibenzodioxin was detected at a maximum estimated concentration of 0.25 ppb.

4.5.2.7 Inorganics - On-Site Sediment

One of the four sediment samples from the wetland contained elevated calcium (3040 ppm) and zinc (236 ppm) relative to background surface soil concentrations (Table 4-38).

4.5.3 Summary of On-Site Sediment Contamination

The WWTA sediment contains low levels of the types of analytes seen in Site surface soils. VOCs were detected in concentrations below 0.2 ppm. PAHs were detected in concentrations below 6 ppm. Pesticides were detected in concentration below 0.6 ppm. 2,3,7,8tetrachlorodibenzofuran was detected in concentrations below 0.05 ppb. In general, the sediment does no appear to be substantially impacted by Site activities.

Table 4-1
Fingerprint Compounds

Irgasan-DP-300
Tinuvin-327
Tinuvin-328
Propazine
Tofranil
Butazolidin

Notes: Fingerprint compounds are specific chemicals unique to the activities at the Cranston Site.

These compounds were selected based on the following:

- a review of chemical production and usage records to identify those chemicals that are unique to the Site but are not part of the Appendix IX list;
- the toxicology of these chemicals; and
- the physicochemical properties of these chemicals, including their potential for degradation and transport.

These compounds were analyzed in the laboratory using USEPA Method 8270.

FIGURE 4-2
GROUNDWATER
PHASE II SAMPLE SUMMARY

PH2SUMGT.XLS
7/28/95 4:34 PM

	AREA	PRODUCTION AREA		WARWICK AREA			
	PHASE-ROUND	II-S	II-S	II-1	II-2	II-1	II-2
	AREA-SUB_AREA	PROD-AOC13	PROD-SMU11	WARWK-SMU16	WARWK-SMU16	WARWK-SMU5	WARWK-SMU5
ANALYTE GROUP	METHOD	Samples	Samples	Samples	Samples	Samples	Samples
ICP METALS	6010W	12	2	2	1	6	3
ARSENIC	7060W	12	2	2	1	6	3
LEAD	7421W	12	2	2	1	6	3
MERCURY	747ZW	12	2	2	1	6	3
POTASSIUM	7610W	NA	NA	NA	1	NA	3
SELENIUM	7740W	12	2	2	1	6	3
THALLIUM	7841W	12	2	2	1	6	3
ORGANOCHLORINE PESTICIDES/PCB's	8080W	12	2	2	1	6	3
ORGANOPHOSPHORUS PESTICIDES	814ZW	12	2	2	1	6	3
HERBICIDES	815ZW	12	2	2	1	6	3
VOLATILE ORGANICS	8240W	12	2	2	1	6	3
SEMIVOLATILE ORGANICS	8270W	12	2	2	1	6	3
CYANIDE	9010W	12	2	2	1	6	3
SULFIDE	9030W	12	2	2	1	6	3
ALKALINITY	ALKZW	12	2	2	1	4	3
BIOLOGICAL OXYGEN DEMAND - 5	BOD5W	12	2	1	1	4	3
CHLORIDE	CHLOW	12	2	2	1	4	3
CHEMICAL OXYGEN DEMAND	CODZW	12	2	1	1	4	3
LANGLIER INDEX	CORRW	12	2	2	1	4	3
TOTAL HARDNESS, AS CACO3	HARDW	12	2	1	1	4	3
AMMONIA AS N	NH3NW	12	2	1	1	4	3
NITRATE-NITRITE AS N	NO32W	12	2	1	1	4	3
OIL AND GREASE	ONGRW	12	2	1	1	4	3
ORTHOPHOSPHATE	OPO4W	12	2	1	1	4	3
PH	PHZZW	12	2	NA	1	NA	3
SILICA,DISSOLVED	SIO2W	11	2	2	1	4	3
SULFATE	SO4ZW	12	2	2	1	4	3
DIOXIN/FURANS	SOWZW	12	2	2	1	5	3
TOTAL DISSOLVED SOLIDS	TDSZW	12	2	1	1	4	3
TKN	TKNZW	12	2	1	1	4	3
TOTAL ORGANIC CARBON	TOCZW	12	2	1	1	4	3
TOTAL ORGANIC HALIDES	TOXZW	12	2	2	1	6	3
HYDROCARBONS	TPHCW	12	2	1	1	4	3
TOTAL SUSPENDED SOLIDS	TSSZW	12	2	1	1	4	3

FIGURE 4-2
GROUNDWATER
PHASE II SAMPLE SUMMARY

PH2SUMGT.XLS
7/28/95 4:34 PM

AREA	WASTE WATER TREATMENT AREA			OFF-SITE	
PHASE-ROUND	II-1	II-1	II-2	II-1	II-2
AREA-SUB_AREA	WWTA-SMU10	WWTA-SMU12	WWTA-SMU12	OFFST-BG	OFFST-BG
METHOD	Samples	Samples	Samples	Samples	Samples
6010W	3	2	1	5	3
7060W	3	2	1	5	3
7421W	3	2	1	5	3
747ZW	3	2	1	5	3
7610W	NA	NA	1	NA	3
7740W	3	2	1	5	3
7841W	3	2	1	5	3
8080W	3	2	1	5	3
814ZW	3	2	1	5	3
815ZW	3	2	1	5	3
8240W	3	2	1	5	3
8270W	3	2	1	5	3
9010W	3	2	1	5	3
9030W	3	2	1	5	3
ALKZW	3	2	1	NA	3
BOD5W	NA	1	1	NA	3
CHLOW	3	2	1	NA	3
CODZW	NA	1	1	NA	3
CORRW	3	2	1	NA	3
HARDW	NA	1	1	NA	3
NH3NW	NA	1	1	NA	3
NO32W	NA	1	1	NA	3
ONGRW	NA	1	1	NA	3
OPO4W	NA	1	1	NA	3
PHZZW	NA	NA	1	NA	3
SIO2W	3	2	1	NA	3
SO4ZW	3	2	1	NA	3
SOWZW	3	2	1	5	3
TDSZW	NA	1	1	NA	3
TKNZW	NA	1	1	NA	3
TOCZW	NA	1	1	NA	3
TOXZW	3	2	1	5	3
TPHCW	NA	1	1	NA	3
TSSZW	NA	1	1	NA	3

TABLE 4-3
CRANSTON SITE
BACKGROUND
GROUNDWATER
ORGANIC DATA

	PHASE / ROUND	IB-1	IB-2	IB-3	II-1	IB-1	IB-2	IB-3	II-1	II-1	II-2	II-1	II-2	II-1	II-2	SHALLOW WELL SUMMARY					IB-1	IB-3	IB-2	ROCK WELL SUMMARY				
	SUB AREA	BG/MW18S	BG/MW18S	BG/MW18S	BG/MW18S	BG/MW19S	BG/MW19S	BG/MW19S	BG/MW19S	BG/MW27S	BG/MW27S	BG/MW28S	BG/MW28S	BG/MW35S	BG/MW35S						BG/RW4	BG/RW4	BG/RW4					
	SAMPLE ID	MW-18S*IB-1	MW-18S*IB-2	MW-18S*IB-3	MW-18S*II-1	MW-19S*IB-1	MW-19S*IB-2	MW-19S*IB-3	MW-19S*II-1	MW-27S*II-1	MW-27S*II-2	MW-28S*II-1	MW-28S*II-2	MW-35S*II-1	MW-35S*II-2						RW-4*IB-1	RW-4*IB-3	RW-4*IB-2					
	COLLECT DATE	1/11/91	4/18/91	9/11/91	8/26/93	1/10/91	4/16/91	9/12/91	8/26/93	8/25/93	5/2/94	8/25/93	5/2/94	8/24/93	5/2/94	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected	1/14/91	9/13/91	4/22/91	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q						Result Q	Result Q	Result Q					
VOLATILE ORGANICS																												
	HALOGENATED																											
8240W	CHLOROBENZENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.1 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1	2.1	2.47	2.1	2.1	2.5 U	2.5 U	2.5 U	0		2.500		
	AROMATICS																											
8240W	ETHYLBENZENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	10	2.5 U	2.5 U	2.5 U	1	10	3.04	10	10	2.5 U	2.5 U	2.5 U	0		2.500		
8240W	TOLUENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	0		2.5			2.5 U	2.5 U	3.5 J	1	3.500	2.830	3.5	3.5
SEMI-VOLATILE ORGANICS																												
	BASE NEUTRALS																											
	PAHs																											
8270W	2-METHYLNAPHTHALENE	5 U	4.75 U	5 U	5 U	5 U	4.75 U	5 U	0.75 J	5 U	5 U	53	5 U	5 U	5 U	2	26.9	8.09	53	0.75	4.75 U	5 U	4.8 U	0		4.850		
8270W	ACENAPHTHENE	5 U	4.75 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	84	2.1 J	5 U	5 U	2	43.1	10.4	84	2.1	4.75 U	5 U	4.8 U	0		4.850		
8270W	ACENAPHTHYLENE	5 U	4.75 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	7.8 J	5 U	5 U	5 U	1	7.8	5.16	7.8	7.8	4.75 U	5 U	4.8 U	0		4.850		
8270W	ANTHRACENE	5 U	4.75 U	5 U	5 U	5 U	4.75 U	5 U	1.3 J	5 U	5 U	5 U	5 U	5 U	5 U	1	1.3	4.7	1.3	1.3	4.75 U	5 U	4.8 U	0		4.850		
8270W	BENZO(A)PYRENE	5 U	4.75 U	5 U	5 U	5 U	4.75 U	5 U	1.6 J	5 U	5 U	5 U	5 U	5 U	5 U	1	1.6	4.72	1.6	1.6	4.75 U	5 U	4.8 U	0		4.850		
8270W	BENZO(B)FLUORANTHENE	5 U	4.75 U	5 U	5 U	5 U	4.75 U	5 U	2.5 J	5 U	5 U	5 U	5 U	5 U	5 U	1	2.5	4.79	2.5	2.5	4.75 U	5 U	4.8 U	0		4.850		
8270W	BENZO(G,H,I)PERYLENE	5 U	4.75 U	5 U	5 U	5 U	4.75 U	5 U	1.2 J	5 U	5 U	5 U	5 U	5 U	5 U	1	1.2	4.69	1.2	1.2	4.75 U	5 U	4.8 U	0		4.850		
8270W	BENZO(K)FLUORANTHENE	5 U	4.75 U	5 U	5 U	5 U	4.75 U	5 U	0.86 J	5 U	5 U	5 U	5 U	5 U	5 U	1	0.86	4.67	0.86	0.86	4.75 U	5 U	4.8 U	0		4.850		
8270W	CHRYSENE	5 U	4.75 U	5 U	5 U	5 U	4.75 U	5 U	2 J	5 U	5 U	5 U	5 U	5 U	5 U	1	2	4.75	2	2	4.75 U	5 U	4.8 U	0		4.850		
8270W	FLUORANTHENE	5 U	4.75 U	5 U	5 U	2 J	4.75 U	5 U	6.2 J	5 U	5 U	1.2 J	5 U	5 U	5 U	3	3.13	4.56	6.2	1.2	4.75 U	5 U	4.8 U	0		4.850		
8270W	FLUORENE	5 U	4.75 U	5 U	5 U	5 U	4.75 U	5 U	1.7 J	5 U	5 U	41	5 U	5 U	5 U	2	21.4	7.3	41	1.7	4.75 U	5 U	4.8 U	0		4.850		
8270W	INDENO(1,2,3-CD)PYRENE	5 U	4.75 U	5 U	5 U	5 U	4.75 U	5 U	1.1 J	5 U	5 U	5 U	5 U	5 U	5 U	1	1.1	4.69	1.1	1.1	4.75 U	5 U	4.8 U	0		4.850		
8270W	NAPHTHALENE	1 J	4.75 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	480	11	5 U	5 U	3	164	39	480	1	4.75 U	5 U	4.8 U	0		4.850		
8270W	PHENANTHRENE	5 U	4.75 U	5 U	5 U	3 J	4.75 U	5 U	8 J	5 U	5 U	19	5 U	5 U	5 U	3	10	6.04	19	3	4.75 U	5 U	4.8 U	0		4.850		
8270W	PYRENE	5 U	4.75 U	5 U	5 U	2 J	4.75 U	5 U	5.8 J	5 U	5 U	5 U	5 U	5 U	5 U	2	3.9	4.81	5.8	2	4.75 U	5 U	4.8 U	0		4.850		
	PHTHALATES																											
8270W	BIS(2-ETHYLHEXYL)PHTHALATE	5 U	4.75 U	5 U	5 U	5 U	9.5 U	2.1 U	5.3 J	5 U	5 U	5 U	5 U	5 U	5 U	1	5.3	5.12	5.3	5.3	4.75 U	1.35 U	4.8 U	0		3.633		
8270W	DIETHYLPHTHALATE	1 J	4.75 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1	1	4.68	1	1	4.75 U	5 U	4.8 U	0		4.850		
	OTHER BASE NEUTRALS																											
8270W	DIBENZOFURAN	5 U	4.75 U	5 U	5 U	5 U	4.75 U	5 U	1.4 J	5 U	5 U	47	5 U	5 U	5 U	2	24.2	7.71	47	1.4	4.75 U	5 U	4.8 U	0		4.850		
8270W	NITROBENZENE	5 U	4.75 U	5 U	5 U	5 U	4.75 U	5 U	0.78 J	5 U	5 U	5 U	5 U	5 U	5 U	1	0.78	4.66	0.78	0.78	4.75 U	5 U	4.8 U	0		4.850		
	ACID EXTRACTABLES																											
	PHENOLS																											
8270W	2,4-DIMETHYLPHENOL	5 U	4.75 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	7.7 J	5 U	5 U	5 U	1	7.7	5.16	7.7	7.7	4.75 U	5 U	4.8 U	0		4.850		
8270W	3&4-METHYLPHENOL	NA	NA	5 U	5 U	NA	NA	5 U	5 U	5 U	5 U	4.7 J	5 U	5 U	5 U	1	4.7	4.97	4.7	4.7	NA	5 U	NA	0		5.000		
ORGANOCHLORINE PESTICIDES																												
8080W	4,4-DDE	0.005 U	0.00475 U	0.05 U	0.05 U	0.0081 J	0.00485 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	1	0.0081	0.0373	0.0081	0.0081	R	0.05 U	0.00475 U	0		0.027		
8080W	4,4-DDT	0.0105 U	0.0095 U	0.05 U	0.05 U	0.024	0.0095 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	1	0.024	0.0395	0.024	0.024	R	0.05 U	0.0095 U	0		0.030		
8080W	ALDRIN	0.042	0.00475 U	0.025 U	0.025 U	0.005 U	0.00485 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	1	0.042	0.0219	0.042	0.042	0.013 J	0.025 U	0.00475 U	1	0.013	0.014	0.013	0.013
8080W	ALPHA-BHC	0.016	0.00475 U	0.025 U	0.025 U	0.01	0.00485 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	2	0.013	0.0204	0.016	0.01	R	0.025 U	0.00475 U	0		0.015		
8080W	ENDOSULFAN II	0.0155 U	0.0145 U	0.05 U	0.05 U	0.015 U	0.0145 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0		0.04			0.0041 J	0.05 U	0.0145 U	1	0.004	0.023	0.0041	0.0041
8080W	HEPTACHLOR EPOXIDE	0.063	0.00475 U	0.025 U	0.025 U	0.005 U	0.00485 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	1	0.063	0.0234	0.063	0.063	R	0.025 U	0.00475 U	0		0.015		
CHLORINATED DIOXINS AND FURANS																												
SOWZW	HPCDF	R	R	R	0.00025 U	R	R	R	0.0002 U	0.00052 F	0.00032 U	0.00015 U	0.000425 U	0.00015 U	0.00041 U	1	0.00052	0.00052	0.00052	0.00052	R	R	R					
SOWZW	OCDD	R	R	R	0.0011 U	R	R	R	0.0037 J	0.0014 U	0.0008 U	0.00105 U	0.00065 U	0.0008 U	0.0006 U	1	0.0037	0.0037	0.0037	0.0037	R	R	R					

All results in ug/l (ppb).

All undetected results listed at half-detection limit.

U - Undetected.

J - Estimated result.

R - Rejected result.

NA - Not analyzed.

F - Estimated maximum concentration

TABLE 4-4
CRANSTON SITE
BACKGROUND GROUNDWATER
INORGANIC DATA

TOTAL METALS

PHASE / ROUND	IB-1	IB-2	IB-3	II-1	IB-1	IB-2	IB-3	II-1	II-1	II-2	II-1	II-2	II-1	II-2	SHALLOW WELL SUMMARY - TOTAL					IB-1	IB-3	IB-2	ROCK WELL SUMMARY - TOTAL				
SUB AREA	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG						BG	BG	BG					
SAMPLE ID	MW-18S*IB-1 [T]	MW-18S*IB-2 [T]	MW-18S*IB-3[T]	MW-18S*II-1[T]	MW-19S*IB-1 [T]	MW-19S*IB-2 [T]	MW-19S*IB-3[T]	MW-19S*II-1[T]	MW-27S*II-1[T]	MW-27S*II-2[T]	MW-28S*II-1[T]	MW-28S*II-2[T]	MW-35S*II-1[T]	MW-35S*II-2[T]						RW-4*IB-1 [T]	RW-4*IB-3[T]	RW-4*IB-2 [T]					
COLLECT DATE	1/11/91	4/18/91	9/11/91	8/26/93	1/10/91	4/16/91	9/12/91	8/26/93	8/25/93	5/2/94	8/25/93	5/2/94	8/24/93	5/2/94						1/14/91	9/13/91	4/22/91					
	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected	Result Q	Result Q	Result Q	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
6010W BARIUM	335	93.1	150	81	359	222	110	170	60	135	150	74.2	32	57.8	14	145	145	359	32	25	39	96.2	3	53.4	53.4	96.2	25
6010W CALCIUM	45400	25600	20000	NA	44900	40000	52000	NA	NA	25000	NA	13000	NA	32000	9	33100	33100	52000	13000	13200	16000	20200	3	16500	16500	20200	13200
6010W CHROMIUM	83	131 J	2000	2600	154	56.2	77	1400	13	177 J	42	5 U	5 U	176 J	12	576	494	2600	13	16	13	25.4	3	18.1	18.1	25.4	13
6010W COBALT	31	14.3	16	5 U	52	24.8	15	26	5 U	5 U	15	5 U	5 U	5 U	8	24.3	16	52	14.3	5 U	5 U	24.5	1	24.5	11.5	24.5	24.5
6010W COPPER	123	23.7	47	51	125	67.5	39	920	12.5 U	12.5 U	25	12.5 U	12.5 U	42.1	10	146	108	920	23.7	10 U	12.5 U	62.6	1	62.6	28.4	62.6	62.6
6010W IRON	64200	14400	16000	NA	111000	39500	17000	NA	NA	21000	NA	4400	NA	22000	9	34400	34400	111000	4400	7260	14000	41700	3	21000	21000	41700	7260
6010W MAGNESIUM	16400	4500	3400	NA	28000	12400	7800	NA	NA	3800	NA	6800	NA	5400	9	9830	9830	28000	3400	3040	4800	11400	3	6410	6410	11400	3040
6010W MANGANESE	4220	971	1500	NA	1750	875	570	NA	NA	250	NA	150	NA	290	9	1180	1180	4220	150	813	1700	2240	3	1580	1580	2240	813
6010W NICKEL	86	210 J	530	370	142	202	74	370	20 U	54.7	20 U	20 U	20 U	43.3	10	208	154	530	43.3	38	50	53.9	3	47.3	47.3	53.9	38
6010W POTASSIUM	16200	4960	5000	NA	14800	5950	3600	NA	NA	NA	NA	NA	NA	NA	6	8420	8420	16200	3600	4590	3200	3240 J	3	3680	3680	4590	3200
6010W SODIUM	32200	16700	28000	NA	13800	10400	9600	NA	NA	90000	NA	15000	NA	18000	9	26000	26000	90000	9600	10800	14000	16400	3	13700	13700	16400	10800
6010W TIN	NA	NA	25 U	25 U	NA	NA	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	0		25			NA	25 U	NA	0		25		
6010W VANADIUM	62	10 U	29	19	115	46.1	32	71	5 U	16.6	24	5 U	5 U	18.8	10	43.4	32.8	115	16.6	10 U	5 U	10 U	0		8.33		
6010W ZINC	171	51	49.5 U	110 J	136.5 U	152	44 U	350 J	66	108	180 J	575	10 U	96.6	10	186	150	575	51	47	190	148	3	128	128	190	47
7060W ARSENIC	59.7 J	12.2 J	20	11	61.7	24.1	6.9	22	5 U	11.8 J	5 U	5 U	5 U	46.9 J	10	27.6	21.2	61.7	6.9	2 U	2.5 U	6.8	1	6.8	3.77	6.8	6.8
7421W LEAD	14.7 U	10.5 J	12	18	45.8	24.1	12	40	2.5 U	14.2 J	7.5	5.7 J	2.5 U	51.5 J	11	21.9	18.6	51.5	5.7	26.9	13	47	3	29	29	47	13
747ZW MERCURY	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0		0.1			0.1 U	0.1 U	0.1 U	0		0.1		
7610W POTASSIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	7800	NA	5800	NA	2300	3	5300	5300	7800	2300	NA	NA	NA	0				
7740W SELENIUM	2.5 U	2.5 U	5 U	5 U	2.5 U	2.5 U	5 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U	0		4.64			2.5 U	5 U	2.5 U	0		3.33		
7841W THALLIUM	2.5 U	2.5 U	5 U	5 U	2.5 U	2.5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0		4.29			2.5 U	5 U	2.5 U	0		3.33		

DISSOLVED METALS

PHASE / ROUND	IB-1	IB-2	IB-3	II-1	IB-1	IB-2	IB-3	II-1	II-1	II-2	II-1	II-2	II-1	II-2	SHALLOW WELL SUMMARY - DISSOLVED					IB-1	IB-3	IB-2	ROCK WELL SUMMARY - DISSOLVED				
SUB AREA	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG	BG						BG	BG	BG					
SAMPLE ID	MW-18S*IB-1 [D]	MW-18S*IB-2 [D]	MW-18S*IB-3[D]	MW-18S*II-1[D]	MW-19S*IB-1 [D]	MW-19S*IB-2 [D]	MW-19S*IB-3[D]	MW-19S*II-1[D]	MW-27S*II-1[D]	MW-27S*II-2[D]	MW-28S*II-1[D]	MW-28S*II-2[D]	MW-35S*II-1[D]	MW-35S*II-2[D]						RW-4*IB-1 [D]	RW-4*IB-3[D]	RW-4*IB-2 [D]					
COLLECT DATE	1/11/91	4/18/91	9/11/91	8/26/93	1/10/91	4/16/91	9/12/91	8/26/93	8/25/93	5/2/94	8/25/93	5/2/94	8/24/93	5/2/94						1/14/91	9/13/91	4/22/91					
	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected	Result Q	Result Q	Result Q	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
6010W BARIUM	18	28.9	54	36	13	10.8	13	5 U	35	65.8	44	26.5	13	10	13	28.3	26.6	65.8	10	17	25	35.4	3	25.8	25.8	35.4	17
6010W CALCIUM	29300	28500	16000	NA	34400	29600	40000	NA	NA	23000	NA	12000	NA	29000	9	26900	26900	40000	12000	12700	14000	18100	3	14900	14900	18100	12700
6010W CHROMIUM	5 U	10.1	5 U	18	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2	14.1	6.29	18	10.1	5 U	5 U	5 U	0		5		
COBALT	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0		5			5 U	5 U	5 U	0		5		
COPPER	10 U	10 U	12.5 U	12.5 U	10 U	10 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	0		11.8			10 U	12.5 U	10 U	0		10.8		
6010W IRON	20 U	121	3.25 U	NA	42 U	216	3.25 U	NA	NA	300	NA	9.5 U	NA	23	4	165	82	300	23	3200	6300	8360	3	5950	5950	8360	3200
6010W MAGNESIUM	3210	2230	2100	NA	4330	2800	5000	NA	NA	2900	NA	5900	NA	4300	9	3640	3640	5900	2100	2490	3700	5170	3	3790	3790	5170	2490
6010W MANGANESE	349	286	390	NA	92	188	71	NA	NA	190	NA	45	NA	9.4	9	180	180	390	9.4	829	1600	1920	3	1450	1450	1920	829
6010W NICKEL	10 U	139	410	480	10 U	197	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	4	307	100	480	139	10 U	20 U	10 U	0		13.3		
6010W POTASSIUM	5250	4040	4500	NA	3610	1500 U	2400	NA	NA	NA	NA	NA	NA	NA	5	3960	3550	5250	2400	4780	3300	1500 U	2	4040	3190	4780	3300
6010W SODIUM	30200	19800	29000	NA	10300	8390	10000	NA	NA	85000	NA	14060	NA	16000	9	24700	24700	85000	8390	9920	14000	17000	3	13600	13600	17000	9920
6010W TIN	NA	NA	25 U	25 U	NA	NA	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	0		25			NA	25 U	NA	0		25		
6010W VANADIUM	10 U	10 U	5 U	5 U	10 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0		6.43			10 U	5 U	10 U	0		8.33		
6010W ZINC	10 U	10 U	28	28	10 U	10 U	10 U	10 U	51	114 J	110	543 J	10 U	10 U	6	146	68.1	543	28	20	43	35.6	3	32.9	32.9	43	20
7060W ARSENIC	2 U	2 U	2.5 U	5 U	2 U	2 U	2.5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0		3.79			2 U	8.6	2 U	1	8.6	4.2	8.6	8.6
7421W LEAD	1.5 U	1.5 U	2.5 U	2.5 U	1.5 U	1.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	0		2.21			1.5 U	2.5 U	8.5 U	0		4.17		
747ZW MERCURY	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0		0.1			0.1 U	0.1 U	0.1 U	0		0.1		
7610W POTASSIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	5200	NA	2700	NA	1500	3	3130	3130	5200	1500	NA	NA	NA	0				
7740W SELENIUM	2.5 U	2.5 U	5 U	5 U	2.5 U	2.5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0		4.29			2.5 U	5 U	2.5 U	0		3.33		
7841W THALLIUM	2.5 U	2.5 U	5 U	5 U	2.5 U	2.5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0		4.29			2.5 U	5 U	2.5 U	0		3.33		

All results in ug/l (ppb).
All undetected results listed at half detection limit.
[T] - unfiltered sample (total).
[D] - filtered sample (dissolved).
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.

TABLE 4-5
CRANSTON SITE
PRODUCTION AREA
SHALLOW GROUNDWATER ORGANIC DATA

	PHASE / ROUND	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-1	IB-2	IB-3
	SUB AREA	AOC13	AOC13	AOC13	AOC13	AOC13	AOC13	AOC13	AOC13	AOC13	SWMU11	SWMU11	SWMU11	AAOI15	AAOI15	SWMU2	SWMU2	SWMU2
	SAMPLE ID	MW-1S*IB-1	MW-1S*IB-2	MW-1S*IB-3	MW-2S*IB-1	MW-2S*IB-2	MW-2S*IB-3	MW-3S*IB-1	MW-3S*IB-2	MW-3S*IB-3	MW-4S*IB-1	MW-4S*IB-2	MW-4S*IB-3	MW-5S*IB-1	MW-5S*IB-2	MW-10S*IB-1	MW-10S*IB-2	MW-10S*IB-3
	COLLECT DATE	12/6/90	4/23/91	9/12/91	1/15/91	4/23/91	9/17/91	1/11/91	4/19/91	9/17/91	1/14/91	4/19/91	9/16/91	1/15/91	4/22/91	1/10/91	4/17/91	9/13/91
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
VOLATILE ORGANICS																		
	HALOGENATED																	
8240W	1,1,1-TRICHLOROETHANE	125 U	600 U	250 U	250 U	125 U	250 U	2.5 U	2.5 U	2.5 U	5 J	50 U	250 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	1,1-DICHLOROETHANE	125 U	600 U	250 U	250 U	125 U	250 U	2.5 U	2.5 U	2.5 U	4 J	50 U	250 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	CHLOROBENZENE	11000	21000	18000	9000	5900	4200	1.3 J	2.5 U	3.4 J	76 J	76 J	250 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	CHLOROFORM	125 U	600 U	250 U	250 U	125 U	250 U	2.5 U	2.5 U	2.5 U	2.5 U	50 U	250 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	TETRACHLOROETHENE	125 U	600 U	250 U	250 U	125 U	250 U	2.5 U	2.5 U	2.5 U	2 J	50 U	250 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	TRANS-1,2-DICHLOROETHENE	125 U	600 U	250 U	140 J	130 J	250 U	2.5 U	2.5 U	2.5 U	2.5 U	50 U	250 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	IODOMETHANE	125 U	600 U	250 U	250 U	125 U	250 U	2.5 U	2.5 U	2.5 U	2.5 U	50 U	250 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	TRICHLOROETHENE	125 U	600 U	250 U	250 U	125 U	250 U	2.5 U	2.5 U	2.5 U	2.5 U	50 U	250 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	VINYL CHLORIDE	250 U	1250 U	500 U	500 U	600	500 U	5 U	5 U	5 U	5 U	100 U	500 U	5 U	5 U	5 U	5 U	5 U
	AROMATICS																	
8240W	BENZENE	125 U	600 U	250 U	100 J	84 J	250 U	2.5 U	2.5 U	2.5 U	5 J	50 U	250 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	ETHYLBENZENE	320	1100 J	250 U	250 U	125 U	250 U	2.5 U	2.5 U	2.5 U	340	410 J	250 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	M&P-XYLENE	240 J	1100 J	340 J	100 J	77 J	250 U	2.5 U	2.5 U	2.5 U	990	1200	950	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	O-XYLENE	48 J	200 J	250 U	54 J	45 J	250 U	2.5 U	2.5 U	2.5 U	390	430 J	400	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	TOLUENE	125 U	600 U	250 U	1000	730	250 U	2.5 U	2.5 U	2.5 U	26000 J	36000	20000	2.5 U	2.5 U	2.5 U	1.6 J	2.5 U
	KETONES/ALDEHYDES																	
8240W	2-BUTANONE	250 U	1250 U	5000 U	500 U	250 U	5000 U	5 U	5 U	50 U	5 U	100 U	500 U	5 U	5 U	5 U	5 U	50 U
SEMI-VOLATILE ORGANICS																		
	BASE NEUTRALS																	
	PAHs																	
8270W	2-METHYLNAPHTHALENE	5.5 U	4.8 U	1.2 J	5 U	4.8 U	0.6 J	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	BENZO(A)ANTHRACENE	5.5 U	4.8 U	5 U	5 U	4.8 U	5 U	1 J	1 J	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	BENZO(A)PYRENE	5.5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	BENZO(B)FLUORANTHENE	5.5 U	4.8 U	5 U	1 J	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	BENZO(G,H,I)PERYLENE	5.5 U	4.8 U	5 U	2 J	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	BENZO(K)FLUORANTHENE	5.5 U	4.8 U	5 U	1 J	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	CHRYSENE	5.5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	0.7 J	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	DIBENZ(A,H)ANTHRACENE	5.5 U	4.8 U	5 U	3 J	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	FLUORANTHENE	5.5 U	4.8 U	5 U	5 U	4.8 U	0.3 J	8 J	7.4 J	9.2 J	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	INDENO(1,2,3-CD)PYRENE	5.5 U	4.8 U	5 U	2 J	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	NAPHTHALENE	7 J	11	9.5 J	26	2 J	12	5 U	4.75 U	5 U	4 J	3.4 J	5.4 J	5 U	4.8 U	5 U	4.7 U	5 U
8270W	PHENANTHRENE	5.5 U	4.8 U	5 U	1 J	4.8 U	0.9 J	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	PYRENE	5.5 U	4.8 U	5 U	5 U	4.8 U	0.2 J	6 J	3.6 J	8.1 J	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
	PHTHALATES																	
8270W	BIS(2-ETHYLHEXYL)PHTHALATE	0.5 U	4.8 U	2.1 U	1 J	4.8 U	0.55 U	5 U	4.75 U	0.55 U	5 U	4.8 U	1.3 J	3 J	4.8 U	5 U	4.7 U	0.4 U
8270W	BUTYLBENZYLPHTHALATE	5.5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	DI-N-BUTYLPHTHALATE	5.5 U	1 J	5 U	1 J	4.8 U	2.4 J	5 U	0.38 J	5 U	5 U	0.7 J	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	DIETHYLPHTHALATE	5.5 U	1 J	5 U	5 U	1 J	5 U	5 U	0.9 J	5 U	5 U	1.5 J	5 U	5 U	4.8 U	5 U	4.7 U	5 U
	HALOGENATED																	
8270W	1,2,4-TRICHLOROBENZENE	5.5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	1,2-DICHLOROBENZENE	3 J	5 J	3.8 J	54	5 J	47	5 U	4.75 U	5 U	25	27	32	5 U	4.8 U	5 U	4.7 U	5 U
8270W	1,3-DICHLOROBENZENE	1 J	1 J	0.88 J	5 U	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	1,4-DICHLOROBENZENE	1 J	3 J	1.6 J	1 J	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	4-CHLOROANILINE	8 J	10	25 U	5 U	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	10 U
8270W	BIS(2-CHLOROETHOXY)METHANE	1 J	4.8 U	5 U	5 U	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	BIS(2-CHLOROETHYL)ETHER	5.5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
	OTHER BASE NEUTRALS																	
8270W	2-NITROANILINE	26.5 U	24 U	25 U	24 U	24 U	25 U	24 U	24 U	25 U	24 U	24 U	25 U	24 U	24 U	24 U	23.5 U	25 U
	ACID EXTRACTABLES																	
	PHENOLS																	
8270W	2,4-DICHLOROPHENOL	5.5 U	4.8 U	1.4 J	5 U	4.8 U	5 U	5 U	4.75 U	5 U	12	10	20	5 U	4.8 U	5 U	4.7 U	5 U
8270W	2-CHLOROPHENOL	240	67	86	23	4 J	35	5 U	4.75 U	5 U	4 J	4.8 U	3.6 J	5 U	4.8 U	5 U	4.7 U	5 U
8270W	4-CHLORO-3-METHYLPHENOL	5.5 U	4.8 U	5 U	5 U	4.8 U	26	5 U	4.75 U	5 U	5 U	5.2 J	16	5 U	4.8 U	5 U	4.7 U	5 U
8270W	PENTACHLOROPHENOL	26.5 U	R R	25 U	3 J	24 U	25 U	24 U	24 U	25 U	24 U	24 U	25 U	24 U	24 U	24 U	23.5 U	25 U
8270W	2,4-DIMETHYLPHENOL	5.5 U	4.8 U	4.7 J	7 J	4.8 U	8.9 J	5 U	4.75 U	5 U	12	10	12	5 U	4.8 U	5 U	4.7 U	5 U
8270W	2-METHYLPHENOL	5.5 U	4.8 U	0.73 J	5 U	4.8 U	4.9 J	5 U	4.75 U	5 U	49	41	45	5 U	4.8 U	5 U	4.7 U	5 U
8270W	3&4-METHYLPHENOL	NA	NA	2.2 J	NA	NA	38	NA	NA	5 U	NA	NA	32	NA	NA	NA	NA	5 U
8270W	4-METHYLPHENOL	1 J	2 J	NA	56	6 J	NA	5 U	4.75 U	NA	43	23	NA	5 U	4.8 U	5 U	4.7 U	NA
8270W	4-NITROPHENOL	26.5 U	24 U	25 U	24 U	24 U	25 U	24 U	24 U	25 U	24 U	24 U	25 U	24 U	24 U	24 U	23.5 U	25 U
8270W	PHENOL	36	4.8 U	16	9 J	4.8 U	15	5 U	4.75 U	5 U	4 J	4.9 J	8.5 J	5 U	4.8 U	5 U	4.7 U	5 U
8270W	2,6-DICHLOROPHENOL	5.5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
	OTHER ACID EXTRACTABLES																	
8270W	BENZYL ALCOHOL	5.5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	4.75 U	5 U	6 J	8.4 J	5 U	5 U	4.8 U	5 U	4.7 U	5 U
8270W	1,1-BIPHENYL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8270W	1,4-DIOXANE	NA	NA	2.4 J	NA	NA	5 U	NA	NA	5 U	NA	NA	5 U	NA	NA	NA	NA	5 U
8270W	2-CYCLOHEXENE-1-OL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8270W	2-CYCLOHEXENE-1-ONE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8270W	ACETOPHENONE	3 J	7 J	2.1 J	5 U	4.8 U	5 U	5 U	4.75 U	5 U	7 J	6.4 J	7.1 J	5 U	4.8 U	5 U	4.7 U	5 U
8270W	ANILINE	3 J	5 J	25 U	5 U	4.8 U	25 U	5 U	4.75 U	25 U	2 J	1.4 J	25 U	5 U	4.8 U	5 U	4.7 U	25 U
8270W	BUTAZOLIDIN	26.5 U	24 U	8.2 J	9 J	24 U	19 J	24 U	24 U	250 U	24 U	24 U	250 U	24 U	24 U	24 U	23.5 U	250 U
8270W	O-TOLUIDINE	1 J	4.8 U	5 U	5 U	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	4.7 U	5 U
FINGERPRINT COMPOUNDS																		
8270W	TINUVIN 327	26.5 U	24 U	50 U	24 U	24 U	50 U	24 U	24 U	50 U	24 U	24 U	50 U	24 U	24 U	24 U	23.5 U	50 U
8270W	IRGASAN DP-300	26.5 U	24 U	50 U	24 U	24 U	50 U	24 U	24 U	50 U	22 J	32 J	15 J	24 U	24 U	24 U	23.5 U	50 U
PCBs																		
8080W	PCB-1248	0.5 U	4.75 U	0.25 U	0.245 U	4.75 U	5 U	0.047 U	0.0475 U	0.25 U	R	4.75 U	2.5 U	0.0475 U	1.7	0.048 U	0.047 U	0.25 U
8080W	PCB-1260	1 U	9.5 U	0.5 U	0.485 U	9.5 U	10 U	0.095 U	0.095 U	0.5 U	R	9.5 U	5 U	0.095 U	0.095 U	0.095 U	0.095 U	0.5 U
ORGANOCHLORINE PESTICIDES																		
8080W	4,4'-DDD	0.05 U	0.475 U	0.05 U	0.0245 U	0.475 U	1 U	0.0047 U	0.00475 U	0.05 U	R	0.475 U	0.5 U	0.00475 U	0.00475 U	0.0048 U	0.0047 U	0.05 U
8080W	4,4'-DDE	0.05 U	0.475 U	0.3 J	0.0245 U	0.475 U	1 U	0.0047 U	0.00475 U	0.05 U	R	0.475 U	0.5 U	0.00475 U	0.00475 U	0.0084 J	0.0047 U	0.05 U
8080W	4,4'-DDT	0.1 U	0.95 U	0.05 U	0.0485 U	0.95 U	1 U	0.0095 U	0.0095 U	0.05 U	R	0.95 U	0.5 U	0.031 J	0.0095 U	0.023	0.011 J	0.05 U
8080W	ALDRIN	0.05 U	0.475 U	0.025 U	0.0245 U	0.475 U	1.25 U	0.0047 U	0.00475 U	0.025 U	R	0.475 U	0.25 U	0.00475 U	0.00475 U	0.0048 U	0.013	0.025 U
8080W	ALPHA-BHC	0.05 U	0.475 U	0.025 U	0.0245 U	0.475 U	0.5 U	0.0047 U	0.00475 U	0.025 U	0.14 J	0.475 U	0.25 U	0.00475 U	0.00475 U	0.015	0.0047 U	0.025 U
8080W	ALPHA-CHLORDANE	0.05 U	0.475 U	0.05 U	0.0245 U	0.475 U	1 U	0.0047 U	0.00475 U	0.05 U	R	0.475 U	0.5 U	0.079	0.00475 U	0.0048 U	0.0047 U	0.05 U
8080W	DELTA-BHC	0.05 U	0.475 U	0.025 U	0.0245 U	0.475 U	0.5 U	0.0047 U	0.00475 U	0.025 U	R	0.475 U	0.25 U	0.021	0.00475 U	0.032	0.0047 U	0.025 U
8080W	DIELDRIN	0.05 U	0.475 U	0.05 U	0.0245 U	0.475 U	1 U	0.0047 U	0.00475 U	0.05 U	R	0.475 U	0.5 U	0.036 J	0.00475 U	0.0048 U	0.012	0.05 U
8080W	ENDOSULFAN II	0.155 U	1.45 U	0.05 U	0.075 U	1.45 U	1 U	0.014 U	0.0145 U	0.05 U	R	1.45 U	0.5 U	0.0145 U	0.0145 U	0.0069 J	0.014 U	0.05 U
8080W	ENDRIN	0.05 U	0.475 U	0.05 U	0.0245 U	0.475 U	1 U	0.0047 U	0.00475 U	0.05 U	0.086 J	0.475 U	0.5 U	0.00475 U	0.00475 U	0.0048 U	0.0047 U	0.05 U
8080W	ENDRIN ALDEHYDE	0.1 U	0.95 U	0.05 U	0.0485 U	0.95 U	1 U	0.0095 U	0.0095 U	0.05 U	R	0.95 U	0.5 U	0.0095 U	0.0095 U	0.011 J	0.0095 U	0.05 U
8080W	GAMMA-BHC	0.05 U	0.475 U	0.025 U	0.0245 U	0.475 U	0.5 U	0.0047 U	0.00475 U	0.025 U	R	0.475 U	0.25 U	0.00475 U	0.014	0.0048 U	0.0047 U	0.025 U
8080W	GAMMA-CHLORDANE	0.05 U	0.475 U	0.05 U	0.0245 U	0.475 U	1 U	0.0047 U	0.00475 U	0.05 U	R	0.475 U	0.5 U	0.12	0.00475 U	0.11	0.0047 U	0.05 U
8080W	HEPTACHLOR	0.05 U	0.475 U	0.19	0.0245 U	0.475 U	0.5 U	0.0047 U	0.00475 U	0.025 U	R	0.475 U	0.25 U	0.00475 U	0.00475 U	0.0048 U	0.0047 U	0.025 U
8080W	HEPTACHLOR EPOXIDE	0.05 U	0.475 U	0.025 U	0.0245 U	0.475 U	0.5 U	0.0095 U	0.00475 U	0.025 U	R	0.475 U	0.25 U	0.054	0.00475 U	0.0048 U	0.0047 U	0.025 U
8080W	ISODRIN	0.05 U	0.475 U	0.01 U	0.095	0.475 U	0.2 U	0.0047 U	0.00475 U	0.01 U	R	0.475 U	0.1 U	0.00475 U	0.00475 U	0.0048 U	0.0047 U	0.01 U
ORGANOPHOSPHOROUS PESTICIDES																		
814ZW	DIMETHOATE	0.5 U	0.12 J	2 U	0.95 U	0.475 U	2 U	0.475 U	0.475 U	2 U	0.475 U	0.475 U	2 U	0.475 U	0.475 U	0.475 U	0.47 U	2 U
814ZW	FAMPHUR	1.3 U	1.2 U	0.75 U	2.4 U	1.2 U	0.75 U	1.2 U	1.2 U	0.75 U	1.2 U	0.1 J	0.75 U	1.2 U	1.2 U	1.2 U	1.2 U	0.75 U
814ZW	SULPOTEPP	0.26 U	0.24 U	0.3 U	0.475 U	0.057 J	0.82	0.235 U	0.24 U	0.3 U	0.24 U	0.24 U	0.3 U	0.24 U	0.24 U	0.24 U	0.235 U	0.3 U
HERBICIDES																		
815ZW	2,4,5-TP (SILVEX)	0.095 U	0.08 U	0.05 U	0.08 U	0.08 U	0.05 U	0.08 U	0.08 U	0.05 U	0.067 J	0.08 U	0.05 U	0.08 U	0.08 U	0.085 U	0.08 U	0.05 U
815ZW	2,4-D	0.65 U	1.4 J	0.25 U	0.55 U	0.55 U	0.25 U	0.55 U	0.55 U	0.25 U	0.6 U	0.55 U	0.25 U	0.55 U	0.55 U	0.6 U	0.55 U	0.25 U
815ZW	DINOSEB	0.65	R	NA	0.07 U	0.066 J	NA	0.07 U	0.07 U	NA	0.07 U	0.07 U	NA	0.07 U	0.07 U	0.075 U	0.07 U	NA
CHLORINATED DIOXINS AND FURANS																		
8270W	TRCDF	10.5 U	9.5 U	NA	9.5 U	9.5 U	NA	9.5 U	9.5 U	NA	9.5 U	9.5 U	NA	9.5 U	9.5 U	9.5 U	9.5 U	NA

All results in ug/l (ppb).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration.
D - Sample diluted.

TABLE 4-
CRANSTON SITE
PRODUCTION AREA
SHALLOW GROUNDWATER ORGANIC DATA

PHASE / ROUND	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	II-S	II-S	II-S	II-S
SUB AREA	SWMU7	SWMU7	SWMU7	SWMU8	SWMU8	SWMU8	SWMU11	SWMU11	SWMU11	AAOI15	AAOI15	AAOI15	AOC13	SWMU11	SWMU11	AOC13
SAMPLE ID	MW-12S*IB-1	MW-12S*IB-2	MW-12S*IB-3	MW-13S*IB-1	MW-13S*IB-2	MW-13S*IB-3	MW-14S*IB-1	MW-14S*IB-2	MW-14S*IB-3	MW-16S*IB-1	MW-16S*IB-2	MW-16S*IB-3	MW-20S*II-S	MW-21S*II-S	MW-21SDUP*II-S	MW-22S*II-S
COLLECT DATE	1/15/91	4/22/91	9/16/91	1/10/91	4/22/91	9/13/91	1/13/91	4/18/91	9/11/91	1/14/91	4/22/91	9/16/91	8/4/92	8/5/92	8/5/92	8/4/92
	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
VOLATILE ORGANICS																
HALOGENATED																
8240W 1,1,1-TRICHLOROETHANE	25 U	2.5 U	25 U	2.5 U	2.5 U	12.5 U	89 J	2500 U	625 U	2.5 U	2.5 U	2.5 U	2.5 U	1250 U	1250 U	12.5 U
8240W 1,1-DICHLOROETHANE	25 U	2.5 U	25 U	3.8 J	2.9 J	12.5 U	2.7 J	2500 U	625 U	2.5 U	2.5 U	2.5 U	2.5 U	1250 U	1250 U	12.5 U
8240W CHLOROBENZENE	25 U	2.5 U	25 U	29	9.4	12.5 U	96 J	2500 U	625 U	2.5 U	2.5 U	2.5 U	2.5 U	1250 U	1250 U	640
8240W CHLOROFORM	25 U	2.5 U	25 U	2.5 U	2.5 U	12.5 U	8.4 J	2500 U	625 U	2 J	1.5 J	2.5 U	2.5 U	1250 U	1250 U	12.5 U
8240W TETRACHLOROETHENE	25 U	2.5 U	25 U	2.5 U	2.5 U	12.5 U	31 J	2500 U	625 U	2.5 U	2.5 U	2.5 U	2.5 U	1250 U	1250 U	12.5 U
8240W TRANS-1,2-DICHLOROETHENE	25 U	2.5 U	25 U	2.5 U	2.5 U	12.5 U	R	2500 U	625 U	2.5 U	2.5 U	2.5 U	2.5 U	1250 U	1250 U	12.5 U
8240W IODOMETHANE	25 U	2.5 U	25 U	2.5 U	2.5 U	12.5 U	R	2500 U	630 J	2.5 U	2.5 U	2.5 U	2.5 U	1250 U	1250 U	12.5 U
8240W TRICHLOROETHENE	25 U	2.5 U	25 U	2.5 U	2.5 U	12.5 U	2.6 J	2500 U	625 U	1 J	2.5 U	2.5 U	2.5 U	1250 U	1250 U	12.5 U
8240W VINYL CHLORIDE	50 U	5 U	50 U	5 U	5 U	25 U	R	5000 U	1250 U	5 U	5 U	5 U	5 U	2500 U	2500 U	25 U
AROMATICS																
8240W BENZENE	25 U	2.5 U	25 U	2.5 U	2.5 U	12.5 U	12 J	2500 U	625 U	2.5 U	2.5 U	2.5 U	2.5 U	1250 U	1250 U	12.5 U
8240W ETHYLBENZENE	590	530 J	350	720	37 J	280	630	2500 U	625 U	2.5 U	2.5 U	2.5 U	2.5 U	1250 U	1250 U	12.5 U
8240W M&P-XYLENE	2400 J	2000 J	7800	870	4.6 J	580	1600	1800 J	910 J	2.5 U	2.5 U	2.5 U	2.5 U	1250 U	1250 U	12.5 U
8240W O-XYLENE	530	360 J	3300	150	2.1 J	230	550	2500 U	625 U	2.5 U	2.5 U	2.5 U	2.5 U	1250 U	1250 U	12.5 U
8240W TOLUENE	1500	26 J	130	1.8 J	2.5 U	14 J	58000	150000 J	46000	8	2.5 U	2.5 U	2.5 U	37000	33000	12.5 U
KETONES/ALDEHYDES																
8240W 2-BUTANONE	50 U	5 U	500 U	5 U	5 U	250 U	21 J	5000 U	R	5 U	5 U	50 U	R	12500 U	12500 U	R
SEMI-VOLATILE ORGANICS																
BASE NEUTRALS																
PAHs																
8270W 2-METHYLNAPHTHALENE	5 U	4.8 U	5 U	5 U	4.8 U	0.7 J	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
8270W BENZO(A)ANTHRACENE	5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
8270W BENZO(A)PYRENE	5 U	4.8 U	5 U	2 J	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
8270W BENZO(B)FLUORANTHENE	5 U	4.8 U	5 U	1 J	4.8 U	5 U	5 U	1 J	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
8270W BENZO(G,H,I)PERYLENE	5 U	4.8 U	5 U	3 J	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
8270W BENZO(K)FLUORANTHENE	5 U	4.8 U	5 U	2 J	4.8 U	5 U	5 U	1 J	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
8270W CHRYSENE	5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
8270W DIBENZ(A,H)ANTHRACENE	5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
8270W FLUORANTHENE	5 U	4.8 U	5 U	5 U	0.72 J	0.4 J	5 U	4.75 U	5 U	5 U	4.8 U	5 U	0.15 J	25 U	25 U	0.19 J
8270W INDENO(1,2,3-CD)PYRENE	5 U	4.8 U	5 U	3 J	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
8270W NAPHTHALENE	2 J	6.8 J	4 J	1 J	4.8 U	0.8 J	9 J	8 J	12	5 U	4.8 U	5 U	5 U	210	240	5 U
8270W PHENANTHRENE	5 U	4.8 U	5 U	5 U	0.78 J	1 J	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
8270W PYRENE	5 U	4.8 U	5 U	2 J	0.7 J	0.3 J	5 U	4.75 U	5 U	5 U	4.8 U	5 U	0.16 J	25 U	25 U	0.21 J
PHTHALATES																
8270W BIS(2-ETHYLHEXYL)PHTHALATE	2 J	4.8 U	5 U	5 U	4.8 U	6.5 U	5 U	4.75 U	5 U	4 J	4.8 U	7.3 J	5 U	25 U	25 U	0.62 J
8270W BUTYLBENZYLPHTHALATE	5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	4.75 U	0.6 J	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
8270W DI-N-BUTYLPHTHALATE	5 U	4.8 U	5 U	5 U	0.53 J	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
8270W DIETHYLPHTHALATE	5 U	4.8 U	5 U	5 U	0.72 J	5 U	5 U	1 J	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
HALOGENATED																
8270W 1,2,4-TRICHLOROBENZENE	5 U	4.8 U	5 U	5 U	4.8 U	5 U	3 J	1 J	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
8270W 1,2-DICHLOROBENZENE	5 U	4.8 U	5 U	5 U	4.8 U	5 U	130	79 J	230 D	5 U	4.8 U	5 U	5 U	21 J	25 J	5 U
8270W 1,3-DICHLOROBENZENE	5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
8270W 1,4-DICHLOROBENZENE	5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	4.75 U	2.2 J	5 U	4.8 U	5 U	5 U	2.3 J	2.8 J	5 U
8270W 4-CHLOROANILINE	5 U	4.8 U	5 U	5 U	4.8 U	10 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	10 U	50 U	50 U	10 U
8270W BIS(2-CHLOROETHOXY)METHANE	5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
8270W BIS(2-CHLOROETHYL)ETHER	5 U	4.8 U	5 U	5 U	4.8 U	1.8 J	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
OTHER BASE NEUTRALS																
8270W 2-NITROANILINE	24 U	24 U	25 U	24 U	24 U	25 U	24 U	12 J	25 U	24 U	24 U	25 U	25 U	125 U	125 U	25 U
ACID EXTRACTABLES																
PHENOLS																
8270W 2,4-DICHLOROPHENOL	5 U	4.8 U	5 U	5 U	4.8 U	5 U	390	1200	620 J	5 U	4.8 U	5 U	5 U	310	350	5 U
8270W 2-CHLOROPHENOL	5 U	4.8 U	5 U	5 U	4.8 U	5 U	3 J	6 J	7.1 J	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
8270W 4-CHLORO-3-METHYLPHENOL	5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	20	23 J	5 U	4.8 U	5 U	5 U	43 J	23 J	5 U
8270W PENTACHLOROPHENOL	24 U	24 U	25 U	24 U	24 U	25 U	24 U	24 U	25 U	24 U	24 U	25 U	25 U	125 U	125 U	25 U
8270W 2,4-DIMETHYLPHENOL	19	42	8.1 J	27	3 J	5.8 J	19	23 J	30	5 U	4.8 U	5 U	5 U	32 J	36 J	5 U
8270W 2-METHYLPHENOL	17	1.7 J	5.3 J	4 J	4.8 U	5 U	160	390	400 D	5 U	4.8 U	5 U	5 U	450	450	5 U
8270W 3&4-METHYLPHENOL	NA	NA	340 D	NA	NA	16	NA	NA	190 D	NA	NA	5 U	5 U	110	130	5 U
8270W 4-METHYLPHENOL	1100	4.1 J	NA	23	4.8 U	NA	96	140	NA	5 U	4.8 U	NA	NA	NA	NA	NA
8270W 4-NITROPHENOL	24 U	24 U	25 U	8 J	24 U	25 U	24 U	24 U	25 U	24 U	24 U	25 U	25 U	125 U	125 U	25 U
8270W PHENOL	17	4.8 U	5 U	5 U	4.8 U	5 U	120	410	370 J	5 U	4.8 U	5 U	5 U	190	210	5 U
8270W 2,6-DICHLOROPHENOL	5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	5 J	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
OTHER ACID EXTRACTABLES																
8270W BENZYL ALCOHOL	5 U	4.8 U	5 U	5 U	4.8 U	5 U	52	140	140 D	5 U	4.8 U	5 U	5 U	21 J	24 J	5 U
8270W 1,1-BIPHENYL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5 U	1.8 J	2.1 J	0.076 J
8270W 1,4-DIOXANE	NA	NA	5 U	NA	NA	5 U	NA	NA	45	NA	NA	5 U	5 U	25 U	10 J	5 U
8270W 2-CYCLOHEXENE-1-OL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.7 J	25 U	25 U	5 U
8270W 2-CYCLOHEXENE-1-ONE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.79 J	25 U	25 U	0.87 J
8270W ACETOPHENONE	1 J	12	1.4 J	5 J	4.8 U	6.3 J	15	43 J	38	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
8270W ANILINE	5 U	4.8 U	25 U	19	1.5 J	1.4 J	19	8 J	25 U	5 U	4.8 U	25 U	25 U	125 U	125 U	25 U
8270W BUTAZOLIDIN	24 U	24 U	250 U	24 U	24 U	8.2 J	24 U	24 U	250 U	24 U	24 U	250 U	25 U	125 U	125 U	25 U
8270W O-TOLUIDINE	5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	25 U	25 U	5 U
FINGERPRINT COMPOUNDS																
8270W TINUVIN 327	24 U	1.4 J	50 U	24 U	24 U	3 J	24 U	24 U	50 U	24 U	24 U	50 U	5 U	25 U	25 U	5 U
8270W IRGASAN DP-300	24 U	24 U	50 U	10 J	3.8 J	6.5 J	2300 J	590	1500 J	24 U	24 U	50 U	5 U	1200	760 J	5 U
PCBs																
8080W PCB-1248	0.0485 U	4.75 U	1.25 U	0.48 U	4.75 U	2.5 U	R	4.75 U	2.5 U	R	0.0475 U	0.25 U	0.5 U	0.5 U	0.5 U	0.5 U
8080W PCB-1260	0.095 U	30	22 J	0.95 U	9.5 U	5 U	R	9.5 U	5 U	R	0.095 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ORGANOCHLORINE PESTICIDES																
8080W 4,4'-DDD	0.025	0.475 U	0.25 U	0.41	0.475 U	0.5 U	R	0.475 U	0.5 U	0.017 J	0.00475 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
8080W 4,4'-DDE	0.00485 U	0.475 U	0.25 U	0.048 U	0.475 U	0.5 U	R	0.475 U	0.5 U	R	0.00475 U	0.05 U	0.05 U	0.5 U	0.5 U	0.05 U
8080W 4,4'-DDT	0.0095 U	0.95 U	0.25 U	0.095 U	0.95 U	0.5 U	R	0.95 U	0.5 U	R	0.0095 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
8080W ALDRIN	0.00485 U	0.475 U	0.125 U	0.048 U	0.475 U	0.25 U	R	0.475 U	0.25 U	0.01 J	0.00475 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
8080W ALPHA-BHC	0.00485 U	0.475 U	0.125 U	0.048 U	0.475 U	0.25 U	R	0.475 U	0.25 U	R	0.00475 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
8080W ALPHA-CHLORDANE	0.00485 U	0.475 U	0.25 U	0.048 U	0.475 U	0.5 U	R	0.475 U	0.5 U	R	0.00475 U	0.05 U	0.025 U	0.25 U	0.25 U	0.025 U
8080W DELTA-BHC	0.00485 U	0.475 U	0.125 U	0.048 U	0.475 U	0.25 U	1.3 J	0.475 U	0.25 U	R	0.00475 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
8080W DIELDRIN	0.00485 U	0.475 U	0.25 U	0.048 U	0.475 U	0.5 U	R	0.475 U	R R	R	0.00475 U	0.05 U	0.05 U	0.5 U	0.5 U	0.05 U
8080W ENDOSULFAN II	0.0145 U	1.45 U	0.25 U	0.145 U	1.45 U	0.5 U	R	1.45 U	0.5 U	R	0.0145 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
8080W ENDRIN	0.00485 U	0.475 U	0.25 U	0.048 U	0.475 U	0.5 U	R	0.475 U	0.5 U	R	0.00475 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
8080W ENDRIN ALDEHYDE	0.0095 U	0.95 U	0.25 U	0.095 U	0.95 U	0.5 U	R	3 J	0.5 U	R	0.027	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
8080W GAMMA-BHC	0.00485 U	0.475 U	0.125 U	0.49	0.475 U	0.25 U	R	1.4 J	0.25 U	R	0.00475 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
8080W GAMMA-CHLORDANE	0.00485 U	0.475 U	0.25 U	2.4	0.475 U	0.5 U	R	0.475 U	0.5 U	R	0.00475 U	0.05 U	0.025 U	0.25 U	0.25 U	0.025 U
8080W HEPTACHLOR	0.00485 U	0.475 U	0.125 U	0.048 U	0.475 U	0.25 U	R	0.475 U	0.25 U	0.017 J	0.00475 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
8080W HEPTACHLOR EPOXIDE	0.00485 U	0.475 U	0.125 U	0.048 U	0.475 U	0.25 U	R	0.475 U	0.25 U	0.02 J	0.00475 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U
8080W ISODRIN	0.01	0.475 U	0.05 U	0.048 U	0.475 U	0.1 U	R	0.475 U	0.1 U	R	0.00475 U	0.01 U	0.025 U	0.025 U	0.025 U	0.025 U
ORGANOPHOSPHOROUS PESTICIDES																
8141W DIMETHOATE	0.48 U	0.475 U	2 U	0.5 U	0.12 J	2 U	0.475 U	0.475 U	2 U	0.475 U	0.475 U	2 U	5 U	5 U	5 U	5 U
8141W FAMPHUR	1.2 U	1.2 U	0.75 U	1.25 U	1.2 U	0.75 U	1.2 U	1.2 U	0.75 U	1.2 U	1.2 U	0.75 U	1.25 U	1.25 U	1.25 U	1.25 U
8141W SULPOTEPP	0.24 U	0.24 U	0.3 U	0.255 U	0.24 U	0.3 U	0.24 U	0.24 U	0.3 U	0.24 U	0.24 U	0.3 U	0.25 U	0.25 U	0.25 U	0.25 U
HERBICIDES																
8151W 2,4,5-TP (SILVEX)	0.08 U	0.08 U	0.05 U	0.08 U	0.08 U	0.05 U	0.085 U	0.41 J	0.05 U	0.08 U	0.08 U	0.05 U	0.25 U	0.25 U	0.25 U	0.25 U
8151W 2,4-D	0.6 U	0.55 U	0.25 U	0.6 U	0.55 U	0.25 U	0.6 U	0.55 U	0.8	0.55 U	0.55 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
8151W DINOSEB	0.07 U	0.07 U	NA	0.52	0.07 U	NA	0.075 U	0.07 U	NA	0.07 U	0.07 U	NA	NA	NA	NA	NA
CHLORINATED DIOXINS AND FURANS																
8270W TRCDF	9.5 U	4.4 J	NA	9.5 U	9.5 U	NA	16 J	30	NA	9.5 U	9.5 U	NA	0 U	0 U	0 U	0 U

All results in ug/l (ppb).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration.
D - Sample diluted.

TABLE 4-5
CRANSTON SITE
PRODUCTION AREA
SHALLOW GROUNDWATER ORGANIC DATA

PHASE / ROUND		II-S	II-S	II-S	II-S	II-S	SHALLOW WELL SUMMARY				
SUB AREA		AOC13	AOC13	AOC13	AOC13	AOC13					
SAMPLE ID		MW-23S*II-S	MW-24S*II-S	MW-29S*II-S	MW-30S*II-S	MW-31S*II-S	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
COLLECT DATE		8/4/92	8/4/92	8/6/92	8/6/92	8/6/92					
		Result Q	Result Q	Result Q	Result Q	Result Q					
VOLATILE ORGANICS											
	HALOGENATED										
8240W	1,1,1-TRICHLOROETHANE	2.5 U	2.5 U	2.5 U	12.5 U	2.5 U	2	47	204	89	5
8240W	1,1-DICHLOROETHANE	2.5 U	2.5 U	2.5 U	12.5 U	2.5 U	4	3.35	202	4	2.7
8240W	CHLOROBENZENE	7.1	2.5 U	5.7	12.5 U	34 J	17	4120	2000	21000	1.3
8240W	CHLOROFORM	2.5 U	2.5 U	2.5 U	12.5 U	2.5 U	3	3.97	202	8.4	1.5
8240W	TETRACHLOROETHENE	2.5 U	2.5 U	2.5 U	12.5 U	2.5 U	2	16.5	202	31	2
8240W	TRANS-1,2-DICHLOROETHENE	2.5 U	2.5 U	2.5 U	12.5 U	2.5 U	2	135	204	140	130
8240W	IODOMETHANE	2.5 U	2.5 U	2.5 U	12.5 U	2.5 U	1	630	207	630	630
8240W	TRICHLOROETHENE	2.5 U	2.5 U	2.5 U	12.5 U	2.5 U	2	1.8	202	2.6	1
8240W	VINYL CHLORIDE	5 U	5 U	5 U	25 U	5 U	1	600	425	600	600
	AROMATICS										
8240W	BENZENE	2.5 U	2.5 U	2.5 U	12.5 U	2.5 U	4	50.3	197	100	5
8240W	ETHYLBENZENE	2.5 U	2.5 U	2.5 U	40 J	2.5 U	12	446	320	1100	37
8240W	M&P-XYLENE	2.5 U	2.5 U	2.5 U	130 J	2.5 U	18	1280	681	7800	4.6
8240W	O-XYLENE	2.5 U	2.5 U	2.5 U	39 J	2.5 U	15	449	340	3300	2.1
8240W	TOLUENE	2.5 U	2.5 U	2.5 U	530 J	2.5 U	18	22800	10800	150000	1.6
	KETONES/ALDEHYDES										
8240W	2-BUTANONE	R	R	25 U	125 U	25 U	1	21	1340	21	21
SEMI-VOLATILE ORGANICS											
	BASE NEUTRALS										
	PAHs										
8270W	2-METHYLNAPHTHALENE	5 U	5 U	5 U	5 U	5 U	3	0.833	5.68	1.2	0.6
8270W	BENZO(A)ANTHRACENE	5 U	5 U	5 U	5 U	5 U	2	1	5.8	1	1
8270W	BENZO(A)PYRENE	5 U	5 U	5 U	5 U	5 U	1	2	5.93	2	2
8270W	BENZO(B)FLUORANTHENE	5 U	5 U	5 U	5 U	5 U	3	1	5.7	1	1
8270W	BENZO(G,H,I)PERYLENE	5 U	5 U	5 U	5 U	5 U	2	2.5	5.88	3	2
8270W	BENZO(K)FLUORANTHENE	5 U	5 U	5 U	5 U	5 U	3	1.33	5.73	2	1
8270W	CHRYSENE	5 U	5 U	5 U	5 U	5 U	1	0.7	5.9	0.7	0.7
8270W	DIBENZ(A,H)ANTHRACENE	5 U	5 U	5 U	5 U	5 U	1	3	5.96	3	3
8270W	FLUORANTHENE	0.31 J	5 U	5 U	5 U	5 U	9	2.96	5.54	9.2	0.15
8270W	INDENO(1,2,3-CD)PYRENE	5 U	5 U	5 U	5 U	5 U	2	2.5	5.88	3	2
8270W	NAPHTHALENE	5 U	5 U	5 U	0.65 J	5 U	20	28.7	17.5	240	0.65
8270W	PHENANTHRENE	5 U	5 U	5 U	5 U	5 U	4	0.92	5.58	1	0.78
8270W	PYRENE	0.095 J	5 U	5 U	5 U	5 U	10	2.14	5.27	8.1	0.095
	PHTHALATES										
8270W	BIS(2-ETHYLHEXYL)PHTHALATE	5 U	5 U	5 U	5 U	5 U	7	2.75	5.07	7.3	0.62
8270W	BUTYLBENZYLPHTHALATE	5 U	5 U	5 U	5 U	5 U	1	0.6	5.89	0.6	0.6
8270W	DI-N-BUTYLPHTHALATE	5 U	5 U	5 U	5 U	5 U	6	1	5.4	2.4	0.38
8270W	DIETHYLPHTHALATE	5 U	5 U	5 U	5 U	5 U	6	1.02	5.41	1.5	0.72
	HALOGENATED										
8270W	1,2,4-TRICHLOROBENZENE	5 U	5 U	5 U	5 U	5 U	2	2	5.86	3	1
8270W	1,2-DICHLOROBENZENE	5 U	5 U	5 U	5 U	5 U	14	49.1	21.2	230	3
8270W	1,3-DICHLOROBENZENE	5 U	5 U	5 U	5 U	5 U	3	0.96	5.68	1	0.88
8270W	1,4-DICHLOROBENZENE	5 U	5 U	5 U	5 U	5 U	7	1.99	4.39	3	1
8270W	4-CHLOROANILINE	10 U	10 U	10 U	10 U	10 U	2	9	9.24	10	8
8270W	BIS(2-CHLOROETHOXY)METHANE	5 U	5 U	5 U	5 U	5 U	1	1	5.89	1	1
8270W	BIS(2-CHLOROETHYL)ETHER	5 U	5 U	5 U	5 U	5 U	1	1.8	5.92	1.8	1.8
	OTHER BASE NEUTRALS										
8270W	2-NITROANILINE	25 U	25 U	25 U	25 U	25 U	1	12	29.5	12	12
	ACID EXTRACTABLES										
	PHENOLS										
8270W	2,4-DICHLOROPHENOL	5 U	5 U	5 U	5 U	5 U	9	324	80.5	1200	1.4
8270W	2-CHLOROPHENOL	5 U	5 U	5 U	5 U	5 U	11	43.5	17.2	240	3
8270W	4-CHLORO-3-METHYLPHENOL	5 U	5 U	5 U	5 U	5 U	7	22.3	8.16	43	5.2
8270W	PENTACHLOROPHENOL	25 U	25 U	25 U	25 U	25 U	1	3	29.4	3	3
8270W	2,4-DIMETHYLPHENOL	5 U	5 U	5 U	0.47 J	5 U	18	16.7	10.5	42	0.47
8270W	2-METHYLPHENOL	5 U	5 U	5 U	5 U	5 U	15	135	56.3	450	0.73
8270W	3&4-METHYLPHENOL	5 U	5 U	5 U	7.9 J	5 U	9	96.2	50.6	340	2.2
8270W	4-METHYLPHENOL	NA	NA	NA	NA	NA	11	136	76.9	1100	1
8270W	4-NITROPHENOL	25 U	25 U	25 U	25 U	25 U	1	8	29.4	8	8
8270W	PHENOL	5 U	5 U	5 U	5 U	5 U	13	108	40.4	410	4
8270W	2,6-DICHLOROPHENOL	5 U	5 U	5 U	5 U	5 U	1	5	6.01	5	5
	OTHER ACID EXTRACTABLES										
8270W	BENZYL ALCOHOL	5 U	5 U	5 U	0.29 J	5 U	8	49	14.2	140	0.29
8270W	1,1-BIPHENYL	5 U	5 U	0.11 J	5 U	5 U	4	1.02	3.23	2.1	0.076
8270W	1,4-DIOXANE	5 U	5 U	5 U	5 U	5 U	3	19.1	8.47	45	2.4
8270W	2-CYCLOHEXENE-1-OL	5 U	0.74 J	5 U	5 U	5 U	2	0.72	8.49	0.74	0.7
8270W	2-CYCLOHEXENE-1-ONE	0.65 J	0.41 J	0.8 J	5 U	5 U	5	0.704	7.06	0.87	0.41
8270W	ACETOPHENONE	5 U	5 U	5 U	5 U	5 U	14	11	8.24	43	1
8270W	ANILINE	25 U	25 U	25 U	0.32 J	25 U	10	6.06	18.9	19	0.32
8270W	BUTAZOLIDIN	25 U	25 U	25 U	25 U	8.9 J	5	10.7	63.5	19	8.2
8270W	O-TOLUIDINE	5 U	5 U	5 U	5 U	5 U	1	1	5.89	1	1
FINGERPRINT COMPOUNDS											
8270W	TINUVIN 327	0.22 J	5 U	5 U	5 U	5 U	3	1.54	24.8	3	0.22
8270W	IRGASAN DP-300	5 U	5 U	5 U	5 U	5 U	11	585	187	2300	3.8
PCBs											
8080W	PCB-1248	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1	1.7	1.46	1.7	1.7
8080W	PCB-1260	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2	26	3.83	30	22
ORGANOCHLORINE PESTICIDES											
8080W	4,4'-DDD	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	3	0.151	0.189	0.41	0.017
8080W	4,4'-DDE	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	2	0.154	0.216	0.3	0.0084
8080W	4,4'-DDT	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	3	0.0217	0.27	0.031	0.011
8080W	ALDRIN	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	2	0.0115	0.152	0.013	0.01
8080W	ALPHA-BHC	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	2	0.0775	0.135	0.14	0.015
8080W	ALPHA-CHLORDANE	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	1	0.079	0.192	0.079	0.079
8080W	DELTA-BHC	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	3	0.451	0.168	1.3	0.021
8080W	DIELDRIN	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	2	0.024	0.201	0.036	0.012
8080W	ENDOSULFAN II	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	1	0.0069	0.359	0.0069	0.0069
8080W	ENDRIN	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	1	0.086	0.18	0.086	0.086
8080W	ENDRIN ALDEHYDE	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	3	1.01	0.328	3	0.011
8080W	GAMMA-BHC	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	3	0.635	0.174	1.4	0.014
8080W	GAMMA-CHLORDANE	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	3	0.877	0.263	2.4	0.11
8080W	HEPTACHLOR	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	2	0.104	0.136	0.19	0.017
8080W	HEPTACHLOR EPOXIDE	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	2	0.037	0.133	0.054	0.02
8080W	ISODRIN	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	2	0.0525	0.111	0.095	0.01
ORGANOPHOSPHOROUS PESTICIDES											
814ZW	DIMETHOATE	5 U	5 U	5 U	5 U	5 U	2	0.12	1.9	0.12	0.12
814ZW	FAMPHUR	1.25 U	1.25 U	1.25 U	1.25 U	1.25 U	1	0.1	1.11	0.1	0.1
814ZW	SULFOTEPP	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	2	0.439	0.272	0.82	0.057
HERBICIDES											
815ZW	2,4,5-TP (SILVEX)	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	2	0.239	0.122	0.41	0.067
815ZW	2,4-D	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	2	1.1	0.454	1.4	0.8
815ZW	DINOSEB	NA	NA	NA	NA	NA	3	0.412	0.125	0.65	0.066
CHLORINATED DIOXINS AND FURANS											
8270W	TRCDF	0 U	0 U	0 U	0 U	0 U	3	16.8	7.34	30	4.4

All results in ug/l (ppb).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration.
D - Sample diluted.

TABLE 4-6
CRANSTON SITE
PRODUCTION AREA
DEEP GROUNDWATER
ORGANIC DATA

	PHASE / ROUND	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	II-S	II-S	II-S	DEEP WELL SUMMARY				
	SUB AREA	AOC13	AOC13	AOC13	SWMU2	SWMU2	SWMU2	SWMU7	SWMU7	SWMU7	AAOI15	AAOI15	AAOI15	AOC13	AOC13	AOC13					
	SAMPLE ID	MW-1D*IB-1	MW-1D*IB-2	MW-1D*IB-3	MW-10D*IB-1	MW-10D*IB-2	MW-10D*IB-3	MW-12D*IB-1	MW-12D*IB-2	MW-12D*IB-3	MW-16D*IB-1	MW-16D*IB-2	MW-16D*IB-3	MW-29D*II-S	MW-30D*II-S	MW-31D*II-S					
	COLLECT DATE	12/6/90	4/23/91	9/11/91	1/10/91	4/17/91	9/12/91	1/11/91	4/22/91	9/11/91	1/14/91	4/22/91	9/12/91	8/6/92	8/6/92	8/6/92	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q					
VOLATILE ORGANICS																					
	HALOGENATED																				
8240W	1,1-DICHLOROETHANE	2.5 U	1 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	5 U	1	1	2.57	1	1
8240W	CHLOROBENZENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1.8 J	1.1 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	230 J	3	77.6	17.5	230	1.1
8240W	TRICHLOROETHENE	2.5 U	4 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	5 U	1	4	2.77	4	4
8240W	VINYL CHLORIDE	5 U	4 J	5 U	5 U	2.2 J	5 U	5 U	3.3 J	5 U	5 U	5 U	5 U	5 U	5 U	10 U	3	3.17	4.97	4	2.2
	AROMATICS																				
8240W	ETHYLBENZENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	35	8.6 J	12	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	5 U	3	18.5	5.87	35	8.6
8240W	M&P-XYLENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	130	32 J	30	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	15 J	4	51.8	15.6	130	30
8240W	O-XYLENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	44	9.8 J	9	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	5 U	3	20.9	6.35	44	9
8240W	TOLUENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	6.1	1.9 J	11 J	2 J	2.5 U	2.5 U	2.5 U	2.5 U	5 U	4	5.25	3.4	11	1.9
SEMI-VOLATILE ORGANICS																					
	BASE NEUTRALS																				
	PAHs																				
8270W	NAPHTHALENE	5 U	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	5 U	4.5 J	1	4.5	4.91	4.5	4.5
8270W	PHTHALATES																				
8270W	BIS(2-ETHYLHEXYL)PHTHALATE	43 U	4.8 U	5 U	1 U	4.75 U	0.8 U	5 U	4.8 U	0.35 U	3 J	4.8 U	1.05 U	5 U	5 U	5 U	1	3	6.22	3	3
	OTHER BASE NEUTRAS																				
8270W	2-CYCLOHEXENE-1-OL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.59 J	5 U	5 U	1	0.59	3.53	0.59	0.59
8270W	ANILINE	5 U	4.8 U	25 U	5 U	4.75 U	25 U	5 U	4.8 U	25 U	5 U	4.8 U	25 U	0.3 J	0.26 J	0.23 J	3	0.263	9.33	0.3	0.26
	ACID EXTRACTABLES																				
	PHENOLS																				
[illegible]W	4-CHLORO-3-METHYLPHENOL	R	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	5 U	5 U	4.8 U	5 U	5 U	5 U	2 J	1	2	4.73	2	2
8270W	2,4-DIMETHYLPHENOL	R	4.8 U	5 U	5 U	4.75 U	5 U	5 U	4.8 U	0.8 J	5 U	4.8 U	5 U	5 U	5 U	5 U	1	0.8	4.64	0.8	0.8
8270W	3&4-METHYLPHENOL	NA	NA	5 U	NA	NA	5 U	NA	NA	24	NA	NA	5 U	5 U	5 U	5 U	1	24	7.71	24	24
8270W	4-METHYLPHENOL	R	4.8 U	NA	5 U	4.75 U	NA	20	11	NA	5 U	4.8 U	NA	NA	NA	NA	2	15.5	7.91	20	11
8270W	PHENOL	5 U	4.8 U	5 U	5 U	4.75 U	5 U	18	6 J	5 U	5 U	4.8 U	5 U	5 U	5 U	5 U	2	12	5.89	18	6
FINGERPRINT COMPOUNDS																					
8270W	BUTAZOLIDIN	25.5 U	24 U	250 U	25 U	24 U	250 U	24 U	24 U	250 U	24 U	24 U	250 U	25 U	25 U	3.1 J	1	3.1	83.2	3.1	3.1
ORGANOCHLORINE PESTICIDES																					
8080W	4,4'-DDT	0.01 U	0.0095 U	0.05 U	0.0095 U	0.0075 J	0.05 U	0.01 U	0.0095 U	0.05 U	R	0.0095 U	0.05 U	0.05 U	0.05 U	0.05 U	1	0.0075	0.0297	0.0075	0.0075
8080W	ALDRIN	0.005 U	0.00475 U	0.025 U	0.00485 U	0.012	0.025 U	0.0047 J	0.00475 U	0.025 U	R	0.00475 U	0.025 U	0.025 U	0.025 U	0.025 U	2	0.00835	0.0154	0.012	0.0047
8080W	ALPHA-BHC	0.005 U	0.00475 U	0.025 U	0.00485 U	0.0047 U	0.025 U	0.0049 U	0.00475 U	0.025 U	0.0099 J	0.00475 U	0.025 U	0.025 U	0.025 U	0.025 U	1	0.0099	0.0146	0.0099	0.0099
8080W	ALPHA-CHLORDANE	0.005 U	0.00475 U	0.05 U	0.00485 U	0.0047 U	0.05 U	0.0049 U	0.013	0.05 U	R	0.00475 U	0.05 U	0.025 U	0.025 U	0.025 U	1	0.013	0.0226	0.013	0.013
8080W	ENDOSULFAN II	0.0155 U	0.0145 U	0.05 U	0.0029 J	0.014 U	0.05 U	0.0145 U	0.0145 U	0.05 U	R	0.0145 U	0.05 U	0.05 U	0.05 U	0.05 U	1	0.0029	0.0315	0.0029	0.0029
8080W	ENDOSULFAN SULFATE	0.0084 J	0.024 U	0.05 U	0.0245 U	0.0235 U	0.05 U	0.0245 U	0.024 U	0.05 U	R	0.024 U	0.05 U	0.05 U	0.05 U	0.05 U	1	0.0084	0.0359	0.0084	0.0084
8080W	GAMMA-CHLORDANE	0.005 U	0.00475 U	0.05 U	0.00485 U	0.017	0.05 U	0.0049 U	0.016	0.05 U	R	0.00475 U	0.05 U	0.025 U	0.025 U	0.025 U	2	0.0165	0.0237	0.017	0.016
CHLORINATED DIOXINS AND FURANS																					
SOWZW	OCDD	NA	NA	R	NA	NA	R	NA	NA	R	NA	NA	R	0.0018 U	0.0017 U	0.003	1	0.003	0.00217	0.003	0.003

All results in ug/l (ppb).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.

TABLE 4-7
CRANSTON SITE
PRODUCTION AREA
BEDROCK GROUNDWATER ORGANIC DATA

PHASE / ROUND	IB-1	IB-2	IB-3	ROCK WELL SUMMARY				
SUB AREA	AOC13	AOC13	AOC13					
SAMPLE ID	RW-1*IB-1	RW-1*IB-2	RW-1*IB-3					
COLLECT DATE	1/15/91	4/23/91	9/17/91	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
	Result Q	Result Q	Result Q					
VOLATILE ORGANICS								
HALOGENATED								
8240W CHLOROBENZENE	1 J	2 J	4.2 J	3	2.4	2.4	4.2	1
SEMI -VOLATILE ORGANICS								
BASE NEUTRALS								
PAHs								
8270W BENZO(G,H,I)PERYLENE	3 J	4.8 U	5 U	1	3	4.27	3	3
ORGANOCHLORINE PESTICIDES								
8080W ALPHA-BHC	0.00475 U	0.017	0.025 U	1	0.017	0.0156	0.017	0.017
8080W DELTA-BHC	0.014	0.00475 U	0.025 U	1	0.014	0.0146	0.014	0.014
8080W ENDOSULFAN II	0.0145 U	0.0016 J	0.05 U	1	0.0016	0.022	0.0016	0.0016
8080W ENDRIN ALDEHYDE	0.0095 U	0.02	0.05 U	1	0.02	0.0265	0.02	0.02
ORGANOPHOSPHOROUS PESTICIDES								
814ZW DIMETHOATE	0.475 U	0.19 J	2 U	1	0.19	0.888	0.19	0.19
814ZW ETHYL PARATHION	0.355 U	0.37 J	0.3 U	1	0.37	0.342	0.37	0.37
814ZW FAMPHUR	1.2 U	0.27 J	0.75 U	1	0.27	0.74	0.27	0.27
814ZW METHYL PARATHION	0.07 U	0.22	0.25 U	1	0.22	0.18	0.22	0.22
814ZW PHORATE	0.355 U	0.064 J	0.3 U	1	0.064	0.24	0.064	0.064
814ZW SULFOTEPP	0.24 U	0.096 J	0.3 U	1	0.096	0.212	0.096	0.096
814ZW THIONAZIN	2.4 U	0.058 J	0.25 U	1	0.058	0.903	0.058	0.058

All results in ug/l (ppb).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.

TABLE 4 - 8
CRANSTON SITE
PRODUCTION AREA
SHALLOW GROUNDWATER
INORGANIC DATA

TOTAL METALS

PHASE / ROUND	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1
SUB AREA	AOC13	AOC13	AOC13	AOC13	AOC13	AOC13	AOC13	AOC13	AOC13	SWMU11	SWMU11	SWMU11	AAOI15	AAOI15	SWMU2	SWMU2	SWMU2	SWMU2	SWMU7	SWMU7	SWMU7	SWMU8
SAMPLE ID	MW-1S [T]	MW-1S*IB-2 [T]	MW-1S*IB-3[T]	MW-2S*IB-1 [T]	MW-2S*IB-2 [T]	MW-2S*IB-3[T]	MW-3S*IB-1 [T]	MW-3S*IB-2 [T]	MW-3S*IB-3[T]	MW-4S*IB-1 [T]	MW-4S*IB-2 [T]	MW-4S*IB-3[T]	MW-5S*IB-1 [T]	MW-5S*IB-2 [T]	MW-10S*IB-1 [T]	MW-10S*IB-2 [T]	MW-10S*IB-3[T]	MW-12S*IB-1 [T]	MW-12S*IB-2 [T]	MW-12S*IB-3[T]	MW-13S*IB-1 [T]
COLLECT DATE	12/6/90	4/23/91	9/12/91	1/15/91	4/23/91	9/17/91	1/11/91	4/19/91	9/17/91	1/14/91	4/19/91	9/16/91	1/15/91	4/22/91	1/10/91	4/17/91	9/13/91	1/15/91	4/22/91	9/16/91	1/10/91
	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
6010W ANTIMONY	NA	NA	12.5 U	NA	NA	31	NA	NA	12.5 U	NA	NA	12.5 U	NA	NA	NA	NA	12.5 U	NA	NA	12.5 U	NA
6010W BARIUM	74	87.4	110	262	402	280	52	58.2	56	43	39.6	47	65	90.3	82	72.5	62	24	35.6	23	362
6010W BERYLLIUM	1 U	1 U	2.5 U	1 U	1 U	2.5 U	1 U	2.7	2.5 U	1 U	1 U	2.5 U	1 U	1 U	1 U	1 U	2.5 U	1 U	1 U	2.5 U	3.3
6010W CADMIUM	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
6010W CALCIUM	73500	86100	110000	65900	61600	66000	22400	23200	22000	51600	43300	51000	19200	21500	61800	34600	26000	58500	48400	56000	107000
6010W CHROMIUM	5 U	16.6	11	5 U	12.4	5 U	5 U	25.8	36	5 U	5 U	5 U	5 U	17.9	58	60 J	37	5 U	17.3	5 U	125
6010W COBALT	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	15	10.5	12	5 U	5 U	5 U	47
6010W COPPER	10 U	10 U	12.5 U	23	38.8	12.5 U	10 U	27.3	12.5 U	10 U	10 U	12.5 U	10 U	10 U	46	50.4	32	10 U	24.9	12.5 U	134
6010W IRON	2170	5880	6200	6560	11100	7200	40500	47500	18000	17700	20300	12000	4620	6900	31300	21300	16000	23200	32400	20000	94400
6010W MAGNESIUM	5600	5170	6500	3320	3120	3500	3360	4040	3600	5700	5480	5400	2490	3600	6280	4420	3300	5810	5270	5400	14200
6010W MANGANESE	1320	1570	3500	157	1520	220	1320	1450	1300	2460	2680	2200	913	1230	878	314	280	3920	3470	3400	6270
6010W NICKEL	10 U	10 U	20 U	10 U	22.9	20 U	10 U	10 U	20 U	10 U	10 U	20 U	10 U	10 U	77	51.3 J	20 U	10 U	26.4	20 U	115
6010W POTASSIUM	10700 J	9570	15000	12200	14000	16000	3330	3400	4100	6200	5520	7300	1500 U	1500 U	4240	1500 U	3000	5700	5140 J	6700	30700
6010W SILVER	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
6010W SODIUM	101000	55000	74000	20400	21100	17000	23200	22600	21000	58100	41600	46000	18200	16900	22000	21800	22000	32800	36200	24000	140000
6010W VANADIUM	10 U	10 U	5 U	10 U	10 U	5 U	10 U	10 U	5 U	10 U	10 U	5 U	10 U	10 U	10 U	10 U	5 U	10 U	10 U	5 U	77
6010W ZINC	10 U	10 U	80 U	340	99.3	820	10 U	24.9	21 U	10 U	10 U	10 U	27	41.3	38 U	44.7	95 U	10 U	64	10 U	717
7041W ANTIMONY	3.5 U	3.5 U	NA	23 J	25	NA	3.5 U	3.5 U	NA	3.5 U	3.5 U	NA	3.5 U	3.5 U	3.5 U	3.5 U	NA	3.5 U	3.5 U	NA	3.5 U
7060W ARSENIC	6	4.5 J	6.5	12.7	16.8 J	21	68.2 J	57.6	37	6	8.6	2.5 U	4.1	2 U	6.7	10.4	6.8	2 U	5.6	9.6	45.6
7421W LEAD	3.5 U	4.7 U	4.5 J	26.6	40	16	6.45 U	27.1	32	1.5 U	1.5 U	2.5 U	12.3	18.2 U	38.7	40.2 J	29	11.8	11.55 U	2.5 U	154
747ZW MERCURY	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	2.3
7740W SELENIUM	2.5 U	2.5 U	10 U	2.5 U	2.5 U	5 U	2.5 U	2.5 U	5 U	2.5 U	2.5 U	5 U	2.5 U	2.5 U	2.5 U	5	5 U	2.5 U	2.5 U	5 U	2.5 U
7010W CYANIDE	5 U	5 U	5 U	22.1	19.8	33	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	11.7	5 U	11	5 U

DISSOLVED METALS

PHASE / ROUND	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1
SUB AREA	AOC13	AOC13	AOC13	AOC13	AOC13	AOC13	AOC13	AOC13	AOC13	SWMU11	SWMU11	SWMU11	AAOI15	AAOI15	SWMU2	SWMU2	SWMU2	SWMU2	SWMU7	SWMU7	SWMU7	SWMU8
SAMPLE ID	MW-1S [D]	MW-1S*IB-2 [D]	MW-1S*IB-3[D]	MW-2S*IB-1 [D]	MW-2S*IB-2 [D]	MW-2S*IB-3[D]	MW-3S*IB-1 [D]	MW-3S*IB-2 [D]	MW-3S*IB-3[D]	MW-4S*IB-1 [D]	MW-4S*IB-2 [D]	MW-4S*IB-3[D]	MW-5S*IB-1 [D]	MW-5S*IB-2 [D]	MW-10S*IB-1 [D]	MW-10S*IB-2 [D]	MW-10S*IB-3[D]	MW-12S*IB-1 [D]	MW-12S*IB-2 [D]	MW-12S*IB-3[D]	MW-13S*IB-1 [D]
COLLECT DATE	12/6/90	4/23/91	9/12/91	1/15/91	4/23/91	9/17/91	1/11/91	4/19/91	9/17/91	1/14/91	4/19/91	9/16/91	1/15/91	4/22/91	1/10/91	4/17/91	9/13/91	1/15/91	4/22/91	9/16/91	1/10/91
	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
6010W BARIUM	121	70.3	110	201	268	220	33	29.1	34	41	34.8	40	33	53.2	16	12.4	16	17	16.3	15	76
6010W CADMIUM	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
6010W CALCIUM	74600	82400	93000	68600	61300	67000	23000	23200	21000	50900	46600	52000	17200	32700	65700	32900	26000	59200	52000	52000	96800
6010W COBALT	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
6010W IRON	867	2100	2600	1470	2110	2100	9160	9420	9000	18000	17900	9700	20 U	20 U	358	166	3.25 U	18600	15100	11000	9950
6010W MAGNESIUM	5590	4900	6200	3460	2970	3500	3250	3560	3200	5670	5610	5500	2100	3470	3130	2170	1900	5590	4280	3900	6660
6010W MANGANESE	1320	1550	3700	156	135	220	1370	1460	1200	2690	2930	2400	5 U	5 U	626	30.3	14	3990	3540	3400	4740
6010W NICKEL	10 U	10 U	20 U	10 U	10 U	20 U	10 U	10 U	20 U	10 U	10 U	20 U	10 U	10 U	25	10 U	20 U	10 U	10 U	20 U	10 U
6010W POTASSIUM	10100 J	9400	15000	12700	13600	16000	3700	3260	4000	6320	5930	7900	1500 U	3180 J	3330	1500 U	3200	5930	5620 J	6700	26500
6010W SILVER	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	3 U	5 U	5 U	5 U	5 U	5 U
6010W SODIUM	101000	54000	79000	21400	21200	18000	23800	22900	23000	58700	43500	52000	14800	18700	21200	20400	25000	32000	40500	28000	146000
6010W ZINC	10 U	10 U	10 U	10 U	38.6	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
7041W ANTIMONY	3.5 U	3.5 U	NA	13.4 J	3.5 U	NA	3.5 U	3.5 U	NA	3.5 U	3.5 U	NA	3.5 U	3.5 U	3.5 U	3.5 U	NA	3.5 U	3.5 U	NA	3.5 U
7060W ARSENIC	4.1	2 U	5 U	6.2	6.6	32	5.2 J	2 U	32	5	6.5	13	2 U	2 U	2 U	2 U	2.5 U	2 U	2 U	15	9.4
7421W LEAD	2.35 U	3.85 U	2.5 U	8.5	4.7 U	2.5 U	1.5 U	1.5 U	2.5 U	1.5 U	1.5 U	2.5 U	4.7	3.15 U	1.5 U	7	2.5 U	1.5 U	1.65 U	2.5 U	1.5 U

All results in ug/l (ppb).
All undetected results listed at half detection limit.
[T] - unifiltered sample (total).
[D] - filtered sample (dissolved).
U - Undetected.
J - Estimated value.
R - Rejected value.
NA - Not analyzed.

TABLE 4 - 8
CRANSTON SITE
PRODUCTION AREA
SHALLOW GROUNDWATER
INORGANIC DATA

TOTAL METALS

PHASE / ROUND	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	II-S	II-S	II-S	II-S	II-S	II-S	II-S	II-S	II-S	SHALLOW WELL SUMMARY - TOTAL				
SUB AREA	SWMU8	SWMU8	SWMU11	SWMU11	SWMU11	AAOI15	AAOI15	AAOI15	AOC13	SWMU11	SWMU11	AOC13	AOC13	AOC13	AOC13	AOC13	AOC13					
SAMPLE ID	MW-13S*IB-2 [T]	MW-13S*IB-3[T]	MW-14S*IB-1 [T]	MW-14S*IB-2 [T]	MW-14S*IB-3[T]	MW-16S*IB-1 [T]	MW-16S*IB-2 [T]	MW-16S*IB-3[T]	MW-20S*II-S[T]	MW-21S*II-S[T]	MW-21SDUP*II-S[T]	MW-22S*II-S[T]	MW-23S*II-S[T]	MW-24S*II-S[T]	MW-29S*II-S[T]	MW-30S*II-S[T]	MW-31S*II-S[T]					
COLLECT DATE	4/22/91	9/13/91	1/14/91	4/18/91	9/11/91	1/14/91	4/22/91	9/16/91	8/4/92	8/5/92	8/5/92	8/4/92	8/4/92	8/4/92	8/6/92	8/6/92	8/6/92	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q					
6010W ANTIMONY	NA	12.5 U	NA	NA	12.5 U	NA	NA	12.5 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	86.1	2	58.6	23.2	86.1	31
6010W BARIUM	99.9	120	60	67	170	67	49.8	64	44.9 J	197 J	177 J	144 J	31.3 J	178 J	51.5 J	32.1 J	1140	38	132	132	1140	23
6010W BERYLLIUM	1 U	2.5 U	1 U	1 U	2.5 U	1 U	1 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	20.4	3	8.8	2.29	20.4	2.7
6010W CADMIUM	2.5 U	2.5 U	2.5 U	9.4 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	12.5 U	1	9.4	2.94	9.4	9.4
6010W CALCIUM	79700	90000	50400	48800	50000	48700	43500	37000	35000	27000	27000	60000	29000	26000	14000	22000	92000	38	49700	49700	110000	14000
6010W CHROMIUM	51.5	19	14	17.1 J	58	22	26.6	150	16.4	82.9	67.8	18.3	129	40.3	144	32.6	618	28	68.7	52	618	11
6010W COBALT	5 U	5 U	5 U	12.8	27	5 U	5 U	5 U	5 U	25.3 J	23.4 J	5 U	5 U	36.4 J	5 U	5 U	338	10	54.7	18.1	338	10.5
6010W COPPER	10 U	12.5 U	10 U	25	52	10 U	10 U	12.5 U	12.5 U	50.9	56.4	12.5 U	29.6	87.6	53.8	67.8	551	17	79.4	41.7	551	23
6010W IRON	15600	20000	11200	8990	15000	12600	10200	4900	14000	40000	38000	11000	9400	110000	57000	17000	68000	38	23900	23900	110000	2170
6010W MAGNESIUM	5930	6700	5080	5350	5500	3900	3110	2300	5300	8900	9500	13000	61000	11000	6700	4400	35000	38	7850	7850	61000	2300
6010W MANGANESE	3490	3400	2880	3980	4400	647	6470	840	275	1200	1100	380	516	17000	450	770	5000	38	2450	2450	17000	157
6010W NICKEL	40.2	20 U	10 U	20.2 J	65	25	24.3	90	20 U	77.5	64.9	20 U	20 U	55.1	102	20 U	549	16	87.9	45.7	549	20.2
6010W POTASSIUM	31100 J	21000	5410	6830	7400	6780	2210 U	6600	3800	7200	6530	22000	3000	6500	2900	4100	16000	34	9410	8600	31100	2900
6010W SILVER	5 U	5 U	5 U	25.8 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1	25.8	5.55	25.8	25.8
6010W SODIUM	95500	160000	51500	104000	76000	24100	14200	22000	15000	160000	170000	23000	25000	20000	22000	21000	30000	38	49200	49200	170000	14200
6010W VANADIUM	10 U	5 U	10 U	10 U	65	10 U	10 U	5 U	5 U	65.4	60	5 U	5 U	24.1 J	10.8 J	5 U	757	7	151	34.5	757	10.8
6010W ZINC	89.2	70 U	25	47.9	75 U	44	46	29.5 U	26.25 U	212	190	24.65 U	25.6 U	117	51.5 U	382	1510	19	255	144	1510	24.9
7041W ANTIMONY	3.5 U	NA	3.5 U	3.5 U	NA	3.5 U	3.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2	24	5.55	25	23
7060W ARSENIC	9.1	36	16.9	11.8 J	23	8.6	5.9	6	5 U	20.6	23.1	5 U	5 U	68.1	56.3	5 U	109	31	23.5	19.9	109	4.1
7421W LEAD	12.75 U	12	7.5	5.6 J	33	5.6	9.2 U	2.5 U	14	24.5	22.9	2.5 U	8.6	49.5	28.1	18	263	25	37	26.4	263	4.5
747ZW MERCURY	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	1	2.3	0.158	2.3	2.3
7740W SELENIUM	2.5 U	5 U	2.5 U	2.5 U	5 U	2.5 U	2.5 U	5 U	R	R	R	R	R	R	R	R	R	1	5	3.53	5	5
CYANIDE	38.7	120	5 U	5 U	5 U	15.6	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	8	34	11.1	120	11

DISSOLVED METALS

PHASE / ROUND	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	II-S	II-S	II-S	II-S	II-S	II-S	II-S	II-S	II-S	SHALLOW WELL SUMMARY-DISSOLVED				
SUB AREA	SWMU8	SWMU8	SWMU11	SWMU11	SWMU11	AAOI15	AAOI15	AOI15	AOC13	SWMU11	SWMU11	AOC13	AOC13	AOC13	AOC13	AOC13	AOC13					
SAMPLE ID	MW-13S*IB-2 [D]	MW-13S*IB-3[D]	MW-14S*IB-1 [D]	MW-14S*IB-2 [D]	MW-14S*IB-3[D]	MW-16S*IB-1 [D]	MW-16S*IB-2 [D]	MW-16S*IB-3[D]	MW-20S*II-S[D]	MW-21S*II-S[D]	MW-21SDUP*II-S[D]	MW-22S*II-S[D]	MW-23S*II-S[D]	MW-24S*II-S[D]	MW-29S*II-S[D]	MW-30S*II-S[D]	MW-31S*II-S[D]					
COLLECT DATE	4/22/91	9/13/91	1/14/91	4/18/91	9/11/91	1/14/91	4/22/91	9/16/91	8/4/92	8/5/92	8/5/92	8/4/92	8/4/92	8/4/92	8/6/92	8/6/92	8/6/92	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q					
6010W BARIUM	80.5	68	37	55.4	47	27	21.7	18	27.1 J	56.3 J	56.8 J	132 J	17.5 J	43.8 J	11.2 J	14.6 J	39.8 J	38	58.2	58.2	268	11.2
6010W CADMIUM	2.5 U	2.5 U	2.5 U	8.1 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1	8.1	2.65	8.1	8.1
6010W CALCIUM	94700	86000	52700	52900	44000	47600	49200	36000	35000	25000	23000	58000	28000	23000	13000	21000	27000	38	47700	47700	96800	13000
6010W COBALT	5 U	5 U	5 U	13.2 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1	13.2	5.22	13.2	13.2
6010W IRON	5450	2600	4930	4640	4300	368	2260	3.25 U	21	2000	1900	57	60	770	25000	8800	6700	34	6160	5510	25000	21
6010W MAGNESIUM	6100	6400	4320	4980	4400	2220	2070	2100	2800	3100	3000	10000	4500	2400	3400	3300	6600	38	4170	4170	10000	1900
6010W MANGANESE	3970	3400	3050	4420	4700	468	7340	68	110	760	720	250	290	5600	240	700	1500	36	2030	1920	7340	14
6010W NICKEL	10 U	20 U	10 U	10 U	20 U	10 U	22.5	20 U	20 U	20 U	20 U	20 U	20 U	20 U	44.1	20 U	20 U	3	30.5	16.1	44.1	22.5
6010W POTASSIUM	37700 J	21000	5590	7130	7700	4960	1715 U	6600	2900	3400	3400	21000	2700	3600	2200	3200	2300	35	8510	7960	37700	2200
6010W SILVER	5 U	5 U	5 U	26 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1	26	5.55	26	26
6010W SODIUM	111000	170000	54500	113000	85000	23500	16200	23000	15000	160000	170000	22000	24000	19000	23000	21000	29000	38	51200	51200	170000	14800
6010W ZINC	10 U	10 U	10 U	29.1 J	10 U	10 U	28.2	10 U	15.05 U	11.4 U	10.7 U	20.7 U	20.1 U	15.6 U	11.15 U	11.6 U	10 U	3	32	12.7	38.6	28.2
7041W ANTIMONY	3.5 U	NA	3.5 U	3.5 U	NA	3.5 U	3.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	13.4	4	13.4	13.4
7060W ARSENIC	4.8	29	14.9	11	15	2 U	4.2	2.5 U	5 U	10.2	5 U	5 U	5 U	5 U	41.6	5 U	20.5	20	14.3	9.06	41.6	4.1
7421W LEAD	7 U	2.5 U	1.5 U	1.5 U	2.5 U	1.5 U	4.55 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	3	6.73	2.83	8.5	4.7

All results in ug/l (ppb).
All undetected results listed at
half detection limit.
[T] - unifiltered sample (total).
[D] - filtered sample (dissolved).
U - Undetected.
J - Estimated value.
R - Rejected value.
NA - Not analyzed.

TABLE 4-9
CRANSTON SITE
PRODUCTION AREA
DEEP GROUNDWATER
INORGANIC DATA

TOTAL METALS

	PHASE / ROUND	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	II-S	II-S	II-S	DEEP WELL SUMMARY - TOTAL				
	SUB AREA	AOC13	AOC13	AOC13	SWMU2	SWMU2	SWMU2	SWMU7	SWMU7	SWMU7	AAOI15	AAOI15	AAOI15	AOC13	AOC13	AOC13					
	SAMPLE ID	MW-1D [T]	MW-1D*IB-2 [T]	MW-1D*IB-3[T]	MW-10D*IB-1 [T]	MW-10D*IB-2 [T]	MW-10D*IB-3[T]	MW-12D*IB-1 [T]	MW-12D*IB-2 [T]	MW-12D*IB-3[T]	MW-16D*IB-1 [T]	MW-16D*IB-2 [T]	MW-16D*IB-3[T]	MW-29D*II-S[T]	MW-30D*II-S[T]	MW-31D*II-S[T]					
	COLLECT DATE	12/6/90	4/23/91	9/11/91	1/10/91	4/17/91	9/12/91	1/11/91	4/22/91	9/11/91	1/14/91	4/22/91	9/12/91	8/6/92	8/6/92	8/6/92	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q					
6010W	BARIUM	23	19.5	17	65	131	63	41	43.9	39	251	137	69	51.1 J	173 J	96.6 J	15	81.3	81.3	251	17
6010W	CADMIUM	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	0		2.5		
6010W	CALCIUM	13200	18300	14000	38400	35000	32000	23500	22600	24000	317000	201000	110000	80000	22000	30000	15	65400	65400	317000	13200
6010W	CHROMIUM	5 U	5 U	5 U	30	95.3 J	35	15	5 U	5 U	32	25.5	12	112	115	53.9	10	52.6	36.7	115	12
6010W	COBALT	19	11.4	15	5 U	25.3	5 U	5 U	5 U	5 U	5 U	5 U	5 U	12.3 J	55.5	18.5 J	7	22.4	13.1	55.5	11.4
6010W	COPPER	54	10 U	12.5 U	21	58.2	26	10 U	10 U	12.5 U	10 U	10 U	12.5 U	42.7	212	90	7	72	39.4	212	21
6010W	IRON	16000	31800	27000	13700	42400	9300	12200	9540	6300	739	138	670	43000	135000	47000	15	26300	26300	135000	138
6010W	MAGNESIUM	3420	4870	3800	8660	12300	6600	5680	5640	5000	500 U	500 U	1700	25000	22000	14000	13	9130	7980	25000	1700
6010W	MANGANESE	3710	4150	4200	4340	3880	2600	640	526	590	15	5 U	63	3000	3500	2100	14	2380	2220	4340	15
6010W	NICKEL	10 U	10 U	20 U	41	103 J	20 U	32	21.4	20 U	10 U	10 U	20 U	73.4	184	46	7	71.5	41.4	184	21.4
6010W	POTASSIUM	1500 U	1500 U	1700	4830	4420	3000	8590	1580 U	3700	10600	2925 U	4300	6100	10000	4200	11	5590	4600	10600	1700
6010W	SILVER	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0		5		
6010W	SODIUM	28100	27000	27000	26100	24400	21000	34000	30200	29000	29100	31200	31000	100000	27000	30000	15	33000	33000	100000	21000
6010W	VANADIUM	10 U	10 U	5 U	10 U	27.2	5 U	10 U	10 U	5 U	10 U	10 U	5 U	17.2 J	80.2	35.4 J	4	40	16.7	80.2	17.2
6010W	ZINC	13.5 U	23.9	14 U	19.5 U	96.3	21 U	29	52.7	10 U	10 U	10 U	55 U	36.75 U	435	242	6	146	71.2	435	23.9
7060W	ARSENIC	7	5 J	8.9	4.3	2 U	2.5 U	2 U	2 U	2.5 U	2 U	2 U	2.5 U	54.9	120	42.8	7	34.7	17.4	120	4.3
7421W	LEAD	3 U	3.95 U	2.5 U	5.25 U	31.9 J	2.5 U	4.65 U	9.85 U	2.5 U	4.8	7.2 U	2.5 U	13.3	45.1	28.3	5	24.7	11.2	45.1	4.8
7740W	SELENIUM	2.5 U	2.5 U	5 U	2.5 U	2.5 U	5 U	2.5 U	2.5 U	5 U	2.5 U	2.5 U	5 U	R	R	R	0		3.33		

DISSOLVED METALS

	PHASE / ROUND	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	II-S	II-S	II-S	DEEP WELL SUMMARY - DISSOLVED				
	SUB AREA	AOC13	AOC13	AOC13	SWMU2	SWMU2	SWMU2	SWMU7	SWMU7	SWMU7	AAOI15	AAOI15	AAOI15	AOC13	AOC13	AOC13					
	SAMPLE ID	MW-1D [D]	MW-1D*IB-2 [D]	MW-1D*IB-3[D]	MW-10D*IB-1 [D]	MW-10D*IB-2 [D]	MW-10D*IB-3[D]	MW-12D*IB-1 [D]	MW-12D*IB-2 [D]	MW-12D*IB-3[D]	MW-16D*IB-1 [D]	MW-16D*IB-2 [D]	MW-16D*IB-3[D]	MW-29D*II-S[D]	MW-30D*II-S[D]	MW-31D*II-S[D]					
	COLLECT DATE	12/6/90	4/23/91	9/11/91	1/10/91	4/17/91	9/12/91	1/11/91	4/22/91	9/11/91	1/14/91	4/22/91	9/12/91	8/6/92	8/6/92	8/5/92	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q					
6010W	BARIUM	14	17.8	16	35	30.2	26	23	31.2	38	245	135	92	15.2 J	23.8 J	20.3 J	15	50.8	50.8	245	14
6010W	CADMIUM	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	6.5	2.5 U	2.5 U	2.5 U	1	6.5	2.77	6.5	6.5
6010W	CALCIUM	11700	17000	13000	38100	32300	29000	24900	22800	23000	309000	195000	110000	76000	12000	25000	15	62600	62600	309000	11700
6010W	CHROMIUM	5 U	5 U	25 U	5 U	5 U	5 U	5 U	5 U	5 U	24	24.6	12	5 U	5 U	5 U	3	20.2	9.37	24.6	12
6010W	COBALT	18	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1	18	5.87	18	18
6010W	COPPER	10 U	10 U	12.5 U	10 U	10 U	12.5 U	10 U	10 U	12.5 U	10 U	10 U	12.5 U	12.5 U	12.5 U	12.5 U	0		11.2		
6010W	IRON	13800	26700	27000	94.5 U	153	180	979	3210	4200	20 U	20 U	33	13000	23000	9100	12	10100	8100	27000	33
6010W	MAGNESIUM	2610	4340	3500	6990	5790	5400	4540	4860	5000	500 U	500 U	33	19000	3600	6200	13	5530	4860	19000	33
6010W	MANGANESE	3810	4030	4500	4380	3320	2600	573	455	570	5 U	5 U	5	2500	2100	1500000	13	118000	102000	1500000	5
6010W	NICKEL	10 U	10 U	20 U	10 U	10 U	20 U	10 U	10 U	20 U	10 U	10 U	20 U	20 U	45.2	20 U	1	45.2	16.3	45.2	45.2
6010W	POTASSIUM	1500 U	1500 U	1700	3770	1500 U	2700	9460	4320 J	3500	10300	5720 J	4400	2900	3800	2200	12	4560	3950	10300	1700
6010W	SILVER	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0		5		
6010W	SODIUM	25800	27200	27000	24500	22300	22000	37500	31100	30000	29000	30500	30000	100000	26000	30000	15	32900	32900	100000	22000
6010W	VANADIUM	10 U	10 U	5 U	10 U	10 U	5 U	10 U	10 U	5 U	10 U	10 U	5 U	5 U	5 U	5 U	0		7.67		
6010W	ZINC	10 U	10 U	23	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	24.15 U	10 U	1	23	11.8	23	23
7060W	ARSENIC	5.3	2 U	6.5	2 U	2 U	2.5 U	2 U	2 U	2.5 U	2 U	2 U	2.5 U	25.9	61.7	25.3	5	24.9	9.75	61.7	5.3
7421W	LEAD	2.1 U	2.05 U	2.5 U	1.5 U	4.4	2.5 U	1.5 U	5.9 U	2.5 U	1.5 U	7.55 U	2.5 U	2.5 U	2.5 U	2.5 U	1	4.4	2.93	4.4	4.4
7740W	SELENIUM	2.5 U	2.5 U	5 U	2.5 U	2.5 U	5 U	2.5 U	2.5 U	5 U	2.5 U	2.5 U	5 U	5 U	25 U	5 U	0		5		

All results in ug/l (ppb).
All undetected results listed at half detection limit.
[T] - unifiltered sample (total).
[D] - filtered sample (dissolved).
U - Undetected.
J - Estimated value.
R - Rejected value.
NA - Not analyzed.

TABLE 4-10
CRANSTON SITE
PRODUCTION AREA
BEDROCK GROUNDWATER INORGANIC DATA

TOTAL METALS

	PHASE / ROUND	IB-1	IB-2	IB-3	ROCK WELL SUMMARY				
	SUB AREA	AOC13	AOC13	AOC13					
	SAMPLE ID	RW-1*IB-1 [T]	RW-1*IB-2 [T]	RW-1*IB-3[T]	Frequency		Average		
	COLLECT DATE	1/15/91	4/23/91	9/17/91	of	Average	Reported	Maximum	Minimum
		Result Q	Result Q	Result Q	Detection	Detected	(with 1/2 detection limit)	Detected	Detected
6010W	BARIUM	48	33	48	3	43	43	48	33
6010W	CALCIUM	49200	33600	39000	3	40600	40600	49200	33600
6010W	IRON	601	251	230	3	361	361	601	230
6010W	MAGNESIUM	7730	7400	6000	3	7040	7040	7730	6000
6010W	MANGANESE	280	291	180	3	250	250	291	180
6010W	POTASSIUM	10300	6200	20000	3	12200	12200	20000	6200
6010W	SODIUM	18200	15700	22000	3	18600	18600	22000	15700
6010W	ZINC	20	10 U	28 U	1	20	19.3	20	20
7421W	LEAD	14.9	3.7 U	2.5 U	1	14.9	7.03	14.9	14.9

DISSOLVED METALS

	PHASE / ROUND	IB-1	IB-2	IB-3	ROCK WELL SUMMARY				
	SUB AREA	AOC13	AOC13	AOC13					
	SAMPLE ID	RW-1*IB-1 [D]	RW-1*IB-2 [D]	RW-1*IB-3[D]	Frequency		Average		
	COLLECT DATE	1/15/91	4/23/91	9/17/91	of	Average	Reported	Maximum	Minimum
		Result Q	Result Q	Result Q	Detection	Detected	(with 1/2 detection limit)	Detected	Detected
6010W	BARIUM	17	21.4	15	3	17.8	17.8	21.4	15
6010W	CALCIUM	15200	24400	12000	3	17200	17200	24400	12000
6010W	IRON	20 U	20 U	3.25 U	0		14.4		
6010W	MAGNESIUM	6410	7280	5000	3	6230	6230	7280	5000
6010W	MANGANESE	10	212	0.75 U	2	111	74.3	212	10
6010W	POTASSIUM	12300	5190	20000	3	12500	12500	20000	5190
6010W	SODIUM	19400	15100	24000	3	19500	19500	24000	15100
6010W	ZINC	10 U	10 U	10 U	0		10		
7421W	LEAD	51.9	3.4 U	2.5 U	1	51.9	19.3	51.9	51.9

All results in ug/l (ppb).
All undetected results listed at half detection limit.
[T] - unifiltered sample (total).
[D] - filtered sample (dissolved).
U - Undetected.
J - Estimated value.
R - Rejected value.
NA - Not analyzed.

TABLE 4-11
CRANSTON SITE
WASTE WATER TREATMENT AREA
ORAGANIC GROUNDWATER DATA

Method	PHASE / ROUND	IB-1	IB-2	IB-3	II-1	IB-1	IB-2	IB-3	II-1	IB-1	IB-2	IB-3	II-1
	SUB AREA	SWMU10	SWMU10	SWMU10	SWMU10	SWMU10	SWMU10	SWMU12	SWMU10	SWMU10	SWMU10	SWMU10	SWMU10
	SAMPLE ID	MW-7S*IB-1	MW-7S*IB-2	MW-7S*IB-3	MW-7S*II-1	MW-8S*IB-1	MW-8S*IB-2	MW-8S*IB-3	MW-8S*II-1	MW-9S*IB-1	MW-9S*IB-2	MW-9S*IB-3	MW-9S*II-1
	COLLECT DATE	1/9/91	4/17/91	9/11/91	8/23/93	1/8/91	4/17/91	9/9/91	8/23/93	1/9/91	4/19/91	9/9/91	8/23/93
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
VOLATILE ORGANICS													
	HALOGENATED												
8240W	1,1,1-TRICHLOROETHANE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1.7 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	1,1-DICHLOROETHANE	2.5 U	2.5 U	2.5 U	2.5 U	1 J	2.4 J	7.2	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	CHLOROBENZENE	2.5 U	2.5 U	2.5 U	2.5 U	2.4 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	CHLOROETHANE	5 U	5 U	5 U	5 U	5 U	5 U	17	5 U	5 U	5 U	5 U	5 U
8240W	CHLOROFORM	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	4.6 J	3.8 J	7.1	2.5 U
8240W	TRICHLOROETHENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
	AROMATICS												
8240W	ETHYLBENZENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	M&P-XYLENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	O-XYLENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
8240W	TOLUENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1.7 J	2.5 U	2.5 U
SEMI-VOLATILE ORGANICS													
	BASE NEUTRALS												
	PAHs												
8270W	2-METHYLNAPHTHALENE	4 J	4.8 U	5 U	5 U	5 U	4.7 U	5 U	5 U	4 J	4.8 U	5 U	5 U
8270W	ACENAPHTHENE	5 U	4.8 U	5 U	5 U	5 U	4.7 U	1.1 J	0.63 J	5 U	4.8 U	5 U	5 U
8270W	ANTHRACENE	5 U	4.8 U	5 U	5 U	1 J	0.62 J	5 U	5 U	5 U	4.8 U	5 U	5 U
8270W	BENZO(A)ANTHRACENE	5 U	4.8 U	5 U	5 U	1 J	1.8 J	5 U	5 U	5 U	4.8 U	5 U	5 U
8270W	BENZO(A)PYRENE	5 U	4.8 U	5 U	5 U	5 U	1.4 J	5 U	1.3 J	5 U	4.8 U	5 U	5 U
8270W	BENZO(B)FLUORANTHENE	5 U	4.8 U	5 U	5 U	1 J	2.3 J	5 U	1.8 J	5 U	4.8 U	5 U	5 U
8270W	BENZO(K)FLUORANTHENE	5 U	4.8 U	5 U	5 U	2 J	2.9 J	5 U	5 U	5 U	4.8 U	5 U	5 U
8270W	CHRYSENE	5 U	4.8 U	5 U	5 U	1 J	1.9 J	5 U	1.9 J	5 U	4.8 U	5 U	5 U
8270W	FLUORANTHENE	5 U	4.8 U	5 U	5 U	3 J	4.2 J	1.9 J	3.4 J	5 U	4.8 U	5 U	5 U
8270W	FLUORENE	5 U	4.8 U	5 U	5 U	5 U	4.7 U	0.5 J	5 U	5 U	4.8 U	5 U	5 U
8270W	NAPHTHALENE	13	4.8 U	5 U	5 U	5 U	4.7 U	5 U	5 U	14	4.8 U	5 U	5 U
8270W	PHENANTHRENE	5 U	4.8 U	5 U	5 U	1 J	1.1 J	5 U	5 U	5 U	4.8 U	5 U	5 U
8270W	PYRENE	5 U	4.8 U	5 U	5 U	3 J	2.2 J	1.5 J	3.2 J	5 U	4.8 U	5 U	5 U
	PHTHALATES												
8270W	BIS(2-ETHYLHEXYL)PHTHALATE	5 U	4.8 U	0.6 U	5 U	3 U	4.7 U	0.4 U	5 U	5 U	4.8 U	0.2 U	5 U
8270W	DI-N-BUTYLPHTHALATE	5 U	4.8 U	5 U	5 U	5 U	4.7 U	5 U	0.76 J	5 U	4.8 U	5 U	5 U
8270W	DI-N-OCTYLPHTHALATE	5 U	4.8 U	5 U	5 U	5 U	4.7 U	5 U	5 U	5 U	4.8 U	5 U	5 U
8270W	DIETHYLPHTHALATE	5 U	4.8 U	5 U	5 U	5 U	4.7 U	5 U	5 U	5 U	4.8 U	5 U	5 U
	HALOGENATED												
8270W	1,2-DICHLOROBENZENE	5 U	4.8 U	5 U	5 U	5 U	4.7 U	5 U	5 U	5 U	4.8 U	5 U	5 U
8270W	4-CHLOROANILINE	5 U	4.8 U	5 U	10 U	5 U	4.7 U	5 U	10 U	5 U	4.8 U	5 U	10 U
	OTHER BASE NEUTRALS												
8270W	N-NITROSODIMETHYLAMINE	5 U	4.8 U	5 U	5 U	5 U	4.7 U	5 U	5 U	5 U	4.8 U	5 U	5 U
8270W	ACETOPHENONE	5 U	4.8 U	5 U	5 U	5 U	4.7 U	5 U	5 U	5 U	4.8 U	5 U	5 U
8270W	ANILINE	5 U	4.8 U	25 U	25 U	5 U	4.7 U	25 U	25 U	5 U	4.8 U	25 U	25 U
	ACID EXTRACTABLES												
	PHENOLS												
8270W	2,4-DICHLOROPHENOL	5 U	4.8 U	5 U	5 U	5 U	4.7 U	5 U	5 U	5 U	4.8 U	5 U	5 U
8270W	4-CHLORO-3-METHYLPHENOL	5 U	4.8 U	5 U	5 U	5 U	4.7 U	5 U	5 U	5 U	4.8 U	5 U	5 U
8270W	3&4-METHYLPHENOL	NA	NA	5 U	5 U	NA	NA	5 U	5 U	NA	NA	5 U	5 U
8270W	4-METHYLPHENOL	5 U	4.8 U	NA	NA	5 U	4.7 U	NA	NA	5 U	4.8 U	NA	NA
8270W	PHENOL	5 U	4.8 U	5 U	5 U	5 U	4.7 U	5 U	5 U	5 U	4.8 U	5 U	5 U
FINGERPRINT COMPOUNDS													
8270W	BUTAZOLIDIN	25.5 U	24 U	250 U	25 U	25 U	23.5 U	250 U	25 U	25.5 U	24 U	250 U	25 U
8270W	PROPAZINE	25.5 U	24 U	100 U	10 U	25 U	23.5 U	100 U	10 U	25.5 U	24 U	100 U	10 U
8270W	IRGASAN DP-300	25.5 U	24 U	50 U	5 U	25 U	23.5 U	50 U	5 U	25.5 U	24 U	50 U	5 U
8270W	TOFRANIL	25.5 U	24 U	25 U	50 U	25 U	23.5 U	25 U	50 U	25.5 U	24 U	25 U	50 U
8270W	TINUVIN 328	NA	NA	NA	5 U	NA	NA	NA	5 U	NA	NA	NA	5 U
ORGANOCHLORINE PESTICIDES													
8080W	4,4'-DDE	0.00485 U	0.0047 U	0.05 U	0.05 U	0.012	0.00475 U	0.05 U	0.05 U	0.00475 U	0.00475 U	0.05 U	0.05 U
8080W	4,4'-DDT	0.0095 U	0.007 J	0.05 U	0.05 U	0.0095 U	0.0095 U	0.05 U	0.05 U	0.0095 U	0.0095 U	0.05 U	0.05 U
8080W	ALDRIN	0.00485 U	0.0047 U	0.025 U	0.025 U	0.0054 J	0.00475 U	0.025 U	0.025 U	0.00475 U	0.011	0.025 U	0.025 U
8080W	ALPHA-BHC	0.00485 U	0.0047 U	0.025 U	0.025 U	0.012	0.00475 U	0.025 U	0.025 U	0.00475 U	0.00475 U	0.025 U	0.025 U
8080W	ALPHA-CHLORDANE	0.0031 J	0.0047 U	0.05 U	0.025 U	0.00475 U	0.00475 U	0.05 U	0.025 U	0.00475 U	0.00475 U	0.05 U	0.025 U
8080W	CHLOROBENZILATE	NA	NA	0.5	0.25 U	NA	NA	0.25 U	0.25 U	NA	NA	0.25 U	0.25 U
8080W	DELTA-BHC	0.012	0.0047 U	0.025 U	0.025 U	0.00475 U	0.00475 U	0.025 U	0.025 U	0.00475 U	0.00475 U	0.025 U	0.025 U
8080W	DIELDRIN	0.00485 U	0.0047 U	0.05 U	0.05 U	0.022	0.00475 U	0.05 U	0.05 U	0.00475 U	0.00475 U	0.05 U	0.05 U
8080W	ENDRIN ALDEHYDE	0.0095 U	0.0095 U	0.05 U	0.05 U	0.0095 U	0.0095 U	0.05 U	0.05 U	0.0095 U	0.0095 U	0.05 U	0.05 U
8080W	GAMMA-CHLORDANE	0.0062 J	0.0047 U	0.05 U	0.025 U	0.00475 U	0.00475 U	0.05 U	0.025 U	0.00475 U	0.00475 U	0.05 U	0.025 U
8080W	HEPTACHLOR	0.00485 U	0.0047 U	0.025 U	0.025 U	0.00475 U	0.045	0.025 U	0.025 U	0.00475 U	0.00475 U	0.025 U	0.025 U
8080W	ISODRIN	0.00485 U	0.0047 U	0.01 U	0.025 U	0.0086 J	0.00475 U	0.01 U	0.025 U	0.00475 U	0.00475 U	0.01 U	0.025 U
HERBICIDES													
8152W	DINOSEB	0.07 U	0.07 U	NA	NA	0.07 U	0.07 U	NA	NA	0.07 U	0.07 U	NA	NA
CHLORINATED DIOXINS AND FURANS													
8270W	TRCDF	10 U	9.5 U	NA	0 U	10 U	9.5 U	NA	0 U	10 U	9.5 U	NA	0 U
8270W	DIBENZOFURAN	5 U	4.8 U	5 U	5 U	5 U	4.7 U	0.4 J	5 U	5 U	4.8 U	5 U	5 U

Method	PHASE / ROUND	IB-1	IB-2	IB-3	II-1	IB-1	IB-2	IB-3	II-1	II-2	IB-1	IB-2	IB-3	SUMMARY				
	SUB AREA	SWMU12	SWMU12	SWMU12	SWMU12	SWMU12	SWMU12	SWMU12	SWMU12	SWMU-12	SWMU10	SWMU10	SWMU12	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
	SAMPLE ID	MW-15S*IB-1	MW-15S*IB-2	MW-15S*IB3	MW-15S*II-1	MW-15D*IB-1	MW-15D*IB-2	MW-15D*IB-3	MW-25S*II-1	MW-25S*II-2	RW-2*IB-1	RW-2*IB-2	RW-2*IB-3					
	COLLECT DATE	1/9/91	4/18/91	9/9/91	8/23/93	1/9/91	4/16/91	9/9/91	8/24/93	5/4/94	1/10/91	4/17/91	9/9/91					
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q					
VOLATILE ORGANICS																		
	HALOGENATED																	
8240W	1,1,1-TRICHLOROETHANE	2.5 U	2.5 U	2.5 U	2.5 U	4.2 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2	2.95	2.54	4.2	1.7
8240W	1,1-DICHLOROETHANE	1.4 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	4	3	2.58	7.2	1
8240W	CHLOROBENZENE	14	11	4.2 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	4	7.9	3.4	14	2.4
8240W	CHLOROETHANE	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1	17	5.5	17	17
8240W	CHLOROFORM	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	3	5.17	2.83	7.1	3.8
8240W	TRICHLOROETHENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.9 J	1	2.9	2.52	2.9	2.9
	AROMATICS																	
8240W	ETHYLBENZENE	4.9 J	3 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2	3.95	2.62	4.9	3
8240W	M&P-XYLENE	23	13	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2	18	3.79	23	13
8240W	O-XYLENE	11	6	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2	8.5	3	11	6
8240W	TOLUENE	30	3.5 U	2.4 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	3	11.4	3.65	30	1.7
SEMI-VOLATILE ORGANICS																		
	BASE NEUTRALS																	
	PAHs																	
8270W	2-METHYLNAPHTHALENE	6 J	4.8 U	5 U	5 U	4 J	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	4	4.5	4.86	6	4
8270W	ACENAPHTHENE	5 U	4.8 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	2	0.865	4.6	1.1	0.63
8270W	ANTHRACENE	5 U	4.8 U	1 J	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	3	0.873	4.44	1	0.62
8270W	BENZO(A)ANTHRACENE	5 U	4.8 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	2	1.4	4.65	1.8	1
8270W	BENZO(A)PYRENE	5 U	4.8 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	2	1.35	4.65	1.4	1.3
8270W	BENZO(B)FLUORANTHENE	5 U	4.8 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	3	1.7	4.54	2.3	1
8270W	BENZO(K)FLUORANTHENE	5 U	4.8 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	2	2.45	4.74	2.9	2
8270W	CHRYSENE	5 U	4.8 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	3	1.6	4.53	1.9	1
8270W	FLUORANTHENE	5 U	4.8 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	4	3.13	4.64	4.2	1.9
8270W	FLUORENE	5 U	4.8 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	1	0.5	4.75	0.5	0.5
8270W	NAPHTHALENE	14	2 J	1 J	5 U	12	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	6	9.33	6.03	14	1
8270W	PHENANTHRENE	5 U	4.8 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	2	1.05	4.63	1.1	1
8270W	PYRENE	5 U	4.8 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	4	2.48	4.53	3.2	1.5
	PHTHALATES																	
8270W	BIS(2-ETHYLHEXYL)PHTHALATE	5 U	4.8 U	0.35 U	5 U	5 U	130	5 U	5 U	5 U	1 U	36	0.35 U	2	83	10.3	130	36
8270W	DI-N-BUTYLPHTHALATE	5 U	1 J	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	2	0.88	4.61	1	0.76
8270W	DI-N-OCTYLPHTHALATE	5 U	4.8 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	1.1 J	5 U	1	1.1	4.79	1.1	1.1
8270W	DIETHYLPHTHALATE	5 U	1 J	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	1	1	4.78	1	1
	HALOGENATED																	
8270W	1,2-DICHLOROBENZENE	2 J	1 J	0.5 J	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	3	1.17	4.47	2	0.5
8270W	4-CHLOROANILINE	4 J	6 J	10 U	10 U	5 U	4.75 U	5 U	10 U	10 U	5 U	4.75 U	5 U	2	5	6.41	6	4
	OTHER BASE NEUTRALS																	
8270W	N-NITROSODIMETHYLAMINE	6 J	4.8 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	1	6	4.98	6	6
8270W	ACETOPHENONE	5 U	3 J	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	1	3	4.87	3	3
8270W	ANILINE	76	86	25 U	25 U	5 U	4.75 U	25 U	25 U	25 U	5 U	4.75 U	25 U	2	81	21.3	86	76
	ACID EXTRACTABLES																	
	PHENOLS																	
8270W	2,4-DICHLOROPHENOL	10	29	4.5 J	4.4 J	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	4	12	6.11	29	4.4
8270W	4-CHLORO-3-METHYLPHENOL	5 U	4.8 U	0.6 J	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	1	0.6	4.76	0.6	0.6
8270W	3&4-METHYLPHENOL	NA	NA	0.5 J	5 U	NA	NA	5 U	5 U	5 U	NA	NA	5 U	1	0.5	4.63	0.5	0.5
8270W	4-METHYLPHENOL	67	41	NA	NA	5 U	4.75 U	NA	NA	NA	5 U	4.75 U	NA	2	54	13.1	67	41
8270W	PHENOL	61	49	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	2	55	9.12	61	49
FINGERPRINT COMPOUNDS																		
8270W	BUTAZOLIDIN	20 J	7 J	7.6 J	25 U	25 U	24 U	250 U	25 U	25 U	24.5 U	24 U	250 U	3	11.5	70	20	7
8270W	PROPAZINE	170	78	43 J	10 U	25 U	24 U	100 U	10 U	10 U	24.5 U	24 U	100 U	3	97	45.7	170	43
8270W	IRGASAN DP-300	670	230	190 D	300 D	26 J	24 U	50 U	5 U	5 U	24.5 U	24 U	50 U	5	283	79.6	670	26
8270W	TOFRANIL	25.5 U	5 J	67	2.5 J	25 U	24 U	25 U	50 U	50 U	24.5 U	24 U	25 U	3	24.8	30	67	2.5
8270W	TINUVIN 328	NA	NA	NA	100	NA	NA	NA	5 U	5 U	NA	NA	NA	1	100	20.8	100	100
ORGANOCHLORINE PESTICIDES																		
8080W	4,4'-DDE	0.048 U	0.475 U	0.25 U	1 U	0.00475 U	0.00475 U	0.05 U	0.05 U	0.05 U	0.0048 U	0.0047 U	0.05 U	1	0.012	0.097	0.012	0.012
8080W	4,4'-DDT	0.095 U	0.95 U	0.25 U	1 U	0.0095 U	0.0095 U	0.05 U	0.05 U	0.05 U	0.0095 U	0.0095 U	0.05 U	1	0.007	0.12	0.007	0.007
8080W	ALDRIN	0.048 U	0.475 U	0.125 U	0.5 U	0.00475 U	0.00475 U	0.025 U	0.025 U	0.025 U	0.0048 U	0.0047 U	0.025 U	2	0.0082	0.0605	0.011	0.0054
8080W	ALPHA-BHC	0.048 U	0.475 U	0.125 U	0.5 U	0.015	0.00475 U	0.025 U	0.025 U	0.025 U	0.0048 U	0.0047 U	0.025 U	2	0.0135	0.061	0.015	0.012
8080W	ALPHA-CHLORDANE	0.048 U	0.475 U	0.25 U	0.5 U	0.00475 U	0.00475 U	0.05 U	0.025 U	0.025 U	0.0048 U	0.0047 U	0.05 U	1	0.0031	0.0706	0.0031	0.0031
8080W	CHLOROBENZILATE	NA	NA	1.25 U	5 U	NA	NA	0.25 U	0.25 U	0.25 U	NA	NA	0.25 U	1	0.5	0.75	0.5	0.5
8080W	DELTA-BHC	0.4	0.475 U	0.125 U	0.5 U	0.00475 U	0.00475 U	0.025 U	0.025 U	0.025 U	0.012	0.0047 U	0.025 U	3	0.141	0.0755	0.4	0.012
8080W	DIELDRIN	0.47	0.475 U	0.25 U	1 U	0.016	0.00475 U	0.05 U	0.05 U	0.05 U	0.0048 U	0.0047 U	0.05 U	3	0.169	0.115	0.47	0.016
8080W	ENDRIN ALDEHYDE	0.095 U	1.6 J	0.25 U	1 U	0.0095 U	0.0095 U	0.05 U	0.05 U	0.05 U	0.0095 U	0.0095 U	0.05 U	1	1.6	0.148	1.6	1.6
8080W	GAMMA-CHLORDANE	0.048 U	0.475 U	0.25 U	1.2 J	0.00475 U	0.00475 U	0.05 U	0.025 U	0.025 U	0.074	0.0047 U	0.05 U	3	0.427	0.103	1.2	0.0062
8080W	HEPTACHLOR	0.048 U	0.475 U	0.125 U	0.5 U	0.00475 U	0.00475 U	0.025 U	0.025 U	0.025 U	0.0048 U	0.0047 U	0.025 U	1	0.045	0.0619	0.045	0.045
8080W	ISODRIN	0.14	0.475 U	0.05 U	0.5 U	0.014	0.00475 U	0.01 U	0.025 U	0.025 U	0.0048 U	0.0047 U	0.01 U	3	0.0542	0.0584	0.14	0.0086
HERBICIDES																		
8152W	DINOSEB	0.07 U	0.07 U	NA	NA	0.07 U	0.07 U	NA	NA	NA	0.038 J	0.07 U	NA	1	0.038	0.0673	0.038	0.038
CHLORINATED DIOXINS AND FURANS																		
8270W	TRCDF	10 U	9.5 U	NA	9.1 J	10 U	9.5 U	NA	0 U	0 U	9.5 U	9.5 U	NA	1	9.1	6.98	9.1	9.1
8270W	DIBENZOFURAN	5 U	4.8 U	5 U	5 U	5 U	4.75 U	5 U	5 U	5 U	5 U	4.75 U	5 U	1	0.4	4.75	0.4	0.4

All results in ug/l (ppb).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
D - Sample diluted.
NA - Not analyzed.

TABLE 4-12
CRANSTON SITE
WASTE WATER TREAMENT AREA
INORGANIC GROUNDWATER DATA

TOTAL METALS

	PHASE / ROUND	IB-1	IB-2	IB-3	II-1	IB-1	IB-2	IB-3	II-1	IB-1	IB-2	IB-3	II-1	IB-1	IB-1	IB-2	IB-2	IB-3	IB-3	IB-3	II-1	II-1	II-2	IB-1	IB-2	IB-3	IB-3	SUMMARY - TOTAL				
	SUB AREA	SWMU10/MW7S	SWMU10/MW7S	SWMU10/MW7S	SWMU10/MW7S	SWMU10/MW8S	SWMU10/MW8S	SWMU10/MW8S	SWMU10/MW8S	SWMU10/MW9S	SWMU10/MW9S	SWMU10/MW9S	SWMU10/MW9S	SWMU12/MW15S	SWMU12/MW15S	SWMU12/MW15S	SWMU12/MW15S	SWMU12/MW15S	SWMU12/MW15S	SWMU12/MW15S	SWMU12/MW15S	SWMU12/MW25S	SWMU-12/MW25	SWMU10/RW2	SWMU10/RW2	SWMU10/RW2	SWMU12/RW2					
	SAMPLE ID	MW-7S*IB-1 [T]	MW-7S*IB-2 [T]	MW-7S*IB-3[T]	MW-7S*II-1[T]	MW-8S [T]	MW-8S*IB-2 [T]	MW-8S*IB-3[T]	MW-8S*II-1[T]	MW-9S*IB-1 [T]	MW-9S*IB-2 [T]	MW-9S*IB-3[T]	MW-9S*II-1[T]	MW-15D*IB-1 [T]	MW-15S [T]	MW-15D*IB-2 [T]	MW-15S*IB-2 [T]	MW-15D*IB-3[T]	MW-15S*IB-3[T]	MW-15S*IB3[T]	MW-15S*II-1[T]	MW-25S*II-1[T]	MW-25S*II-2[T]	RW-2*IB-1 [T]	RW-2*IB-2 [T]	RW-2*IB-3[T]	RW-2*IB-3[T]	Frequency	Average	Average	Maximum	Minimum
	COLLECT DATE	1/9/91	4/17/91	9/11/91	8/23/93	1/8/91	4/17/91	9/9/91	8/23/93	1/9/91	4/19/91	9/9/91	8/23/93	1/9/91	1/9/91	4/16/91	4/18/91	9/9/91	9/9/91	9/9/91	8/23/93	8/24/93	5/4/94	1/10/91	4/17/91	9/9/91	9/9/91	of	Detected	Reported	Detected	Detected
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Detection		(with 1/2 detection limit)		
6010W	BARIUM	95	83.8	67	200	94	46.7	110	59	28	28	20	31	38	111	71.5	137	75	NA	150	84	97	204	56	93.1	NA	79	24	83.8	83.8	204	20
6010W	BERYLLIUM	1 U	1 U	2.5 U	2.5 U	1 U	1 U	2.5 U	2.5 U	1 U	1 U	2.5 U	2.5 U	1 U	1 U	2.7	1 U	2.5 U	NA	2.5 U	2.5 U	2.5 U	2.5 U	1 U	NA	2.5 U	2.5 U	1	2.7	1.82	2.7	2.7
6010W	CADMIUM	2.5 U	2.5 U	2.5 U	7.7	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	NA	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	NA	2.5 U	2.5 U	1	7.7	2.72	7.7	7.7
6010W	CALCIUM	18200	18800	20000	22000	37400 J	33300	27000	21000	10600	11500	8700	17000	47400	53800	37600	51700	29000	35000	NA	24000	21000	20000	24500	33300	30000	NA	24	27200	27200	53800	8700
6010W	CHROMIUM	25	18.3 J	15	28	14 U	35.7 J	68	45	5 U	5 U	11	16	5 U	31	15.5	69.7 J	10	NA	38	20	32	48.7 J	5 U	5 U	NA	5 U	17	31	23.8	69.7	10
6010W	COBALT	5 U	5 U	5 U	13	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	19.5	5 U	NA	19	17	11	19.8	5 U	5 U	NA	10	7	15.6	8.1	19.8	10
6010W	COPPER	10 U	10 U	12.5 U	28	29	10 U	36	31	10 U	10 U	12.5 U	12.5 U	10 U	10 U	26.8	12.5 U	12.5 U	NA	26	12.5 U	12.5 U	64	10 U	10 U	NA	12.5 U	7	34.4	17.8	64	26
6010W	IRON	70500	63000	26000	260000	24600 J	12200	10000	13000	1390	2500	1100	1800	4950	27400	23100	36100	19000	24000	NA	27000	14000	110000	9880	19200	21000	NA	24	34200	34200	260000	1100
6010W	MAGNESIUM	5700	4970	5100	5500	5800	6690	4800	5600	1680	1970	1300	2700	3680	7210	6380	6690	5400	4900	NA	5400	4000	7300	4290	7670	7100	NA	24	5080	5080	7670	1300
6010W	MANGANESE	993	890	1000	1200	1340	1410	1100	1300	625	534	280	620	328	1660	858	1970	980	1700	NA	1200	2600	2500	732	1160	1400	NA	24	1180	1180	2600	280
6010W	NICKEL	10 U	10 U	20 U	20 U	10 U	10 U	20 U	20 U	10 U	10 U	20 U	20 U	10 U	43	30.9	81.1 J	20 U	NA	68	54	20 U	44.6	10 U	10 U	NA	20 U	6	53.6	24.7	81.1	30.9
6010W	POTASSIUM	1500 U	1500 U	1700	1900	8240	6160	5200	3800	3850	3790	4000	6500	1500 U	13800	1500 U	14300	1900	7100	NA	4600	5400	NA	6140	1500 U	1800	NA	18	5570	4680	14300	1700
6010W	SILVER	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	15.4 J	5 U	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	5 U	1	15.4	5.43	15.4	15.4
6010W	SODIUM	12900	11700	12000	13000	22100	16900	18000	19000	16400	17100	14000	27000	11500	30300	12600	29000	11000	19000	NA	16000	18000	19000	23300	19600	12000	NA	24	17600	17600	30300	11000
6010W	VANADIUM	10 U	10 U	5 U	5 U	10 U	10 U	5 U	5 U	10 U	10 U	5 U	5 U	10 U	10 U	10 U	10 U	5 U	NA	31	12	19	45.7	10 U	10 U	NA	5 U	4	26.9	11.2	45.7	12
6010W	ZINC	10 U	30.3	13.5 U	52 J	102 J	67.6	220 J	74 J	10 U	10 U	22 U	10 U	10 U	49.5 U	170	119	27.5 U	NA	290 J	120 J	43 J	108	14.5 U	52.1	NA	21.5 U	13	111	68.6	290	30.3
7060W	ARSENIC	33.9	52.4	26	360	5.5	2 U	2.5 U	5 U	2 U	2 U	2.5 U	5 U	7.2	28.7	8.9	36.5 J	10	NA	29	24	41	167 J	8.5	17.8	NA	22	17	51.7	37.5	360	5.5
7421W	LEAD	8.75 U	8.9 J	2.5 U	6.4	12.5 U	19.5 J	33	22	2.45 U	1.5 U	2.5 U	2.5 U	2.7 U	6.15 U	6.5	8.5 J	2.5 U	NA	18	7.1	6.8	18.6 J	6.3 U	33.8 J	NA	13	13	15.5	10.5	33.8	6.4
7610W	POTASSIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4200	NA	NA	NA	NA	1	4200	4200	4200	4200

DISSOLVED METALS

	PHASE / ROUND	IB-1	IB-2	IB-3	II-1	IB-1	IB-2	IB-3	II-1	IB-1	IB-2	IB-3	II-1	IB-1	IB-1	IB-2	IB-2	IB-3	IB-3	IB-3	II-1	II-1	II-2	IB-1	IB-2	IB-3	IB-3	SUMMARY - DISSOLVED				
	SUB AREA	SWMU10/MW7S	SWMU10/MW7S	SWMU10/MW7S	SWMU10/MW7S	SWMU10/MW8S	SWMU10/MW8S	SWMU10/MW8S	SWMU10/MW8S	SWMU10/MW9S	SWMU10/MW9S	SWMU10/MW9S	SWMU10/MW9S	SWMU12/MW15S	SWMU12/MW15S	SWMU12/MW15S	SWMU12/MW15S	SWMU12/MW15S	SWMU12/MW15S	SWMU12/MW15S	SWMU12/MW15S	SWMU12/MW25S	SWMU-12/MW25	SWMU10/RW2	SWMU10/RW2	SWMU10/RW2	SWMU12/RW2					
	SAMPLE ID	MW-7S*IB-1 [D]	MW-7S*IB-2 [D]	MW-7S*IB-3[D]	MW-7S*II-1[D]	MW-8S [D]	MW-8S*IB-2 [D]	MW-8S*IB-3[D]	MW-8S*II-1[D]	MW-9S*IB-1 [D]	MW-9S*IB-2 [D]	MW-9S*IB-3[D]	MW-9S*II-1[D]	MW-15D*IB-1 [D]	MW-15S [D]	MW-15D*IB-2 [D]	MW-15S*IB-2 [D]	MW-15D*IB-3[D]	MW-15S*IB-3[D]	MW-15S*IB3[D]	MW-15S*II-1[D]	MW-25S*II-1[D]	MW-25S*II-2[D]	RW-2*IB-1 [D]	RW-2*IB-2 [D]	RW-2*IB-3[D]	RW-2*IB-3[D]	Frequency	Average	Average	Maximum	Minimum
	COLLECT DATE	1/9/91	4/17/91	9/11/91	8/23/93	1/8/91	4/17/91	9/9/91	8/23/93	1/9/91	4/19/91	9/9/91	8/23/93	1/9/91	1/9/91	4/16/91	4/18/91	9/9/91	9/9/91	9/9/91	8/23/93	8/24/93	5/4/94	1/10/91	4/17/91	9/9/91	9/9/91	of	Detected	Reported	Detected	Detected
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Detection		(with 1/2 detection limit)		
6010W	BARIUM	48	48.2	55	52	45	33.4	53	35	18	18.1	14	22	19	64	47.2	103	58	NA	63	46	43	49.6	163	215	NA	53	24	56.9	56.9	215	14
6010W	CALCIUM	17600	18700	18000	20000	33400 J	33500	30000	19000	10500	10200	8600	17000	40400	53400	32200	49900	29000	33000	NA	23000	20000	17000	17500	24000	26000	NA	24	25100	25100	53400	8600
6010W	COBALT	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10.8 J	5 U	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	5 U	1	10.8	5.24	10.8	10.8
6010W	IRON	9550	5850	13000	3600	8480 J	7480	9800	5700	63.5 U	20 U	3.25 U	29	37.5 U	2730	6420	11400	12000	5000	NA	11000	9300	11000	2660	4620	8400	NA	20	7400	6170	13000	29
6010W	MAGNESIUM	4680	4790	4900	5200	5280	6290	5100	5200	1610	1560	1200	2500	3080	3640	4560	4700	5100	4300	NA	4900	3700	4400	2980	4090	5000	NA	24	4120	4120	6290	1200
6010W	MANGANESE	879	871	1000	930	1310	1340	1200	1200	405	206	98	240	24	1370	614	1790	970	1500	NA	1100	2400	2000	537	724	1100	NA	24	992	992	2400	24
6010W	NICKEL	10 U	10 U	20 U	20 U	10 U	10 U	20 U	20 U	10 U	10 U	20 U	20 U	10 U	10 U	10 U	44.8	20 U	NA	20 U	20 U	20 U	20 U	10 U	10 U	NA	20 U	1	44.8	16.5	44.8	44.8
6010W	POTASSIUM	1500 U	1500 U	1600	1600	7580	6180 J	6700	2900	3750	3560	4000	5700	1500 U	13600	1500 U	14200	1800	6900	NA	4000	3800	NA	6580	1500 U	1500	NA	18	5330	4500	14200	1500
6010W	SILVER	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10.4 J	5 U	NA	5 U	5 U	5 U	5 U	5 U	5 U	NA	5 U	1	10.4	5.23	10.4	10.4
6010W	SODIUM	11100	11000	12000	12000	18700	16500	19000	18000	16700	15800	15000	28000	11400	30600	11000	29000	12000	20000	NA	16000	17000	18000	21800	20600	13000	NA	24	17300	17300	30600	11000
6010W	ZINC	10 U	10 U	10 U	10 U	25 J	10 U	10 U	10 U	21.5 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NA	10 U	10 U	10 U	10 U	33.5 U	90.8 J	NA	24	3	46.6	16	90.8	24
7060W	ARSENIC	2 U	2 U	7.8	5 U	2 U	2 U	2.5 U	5 U	2 U	2 U	2.5 U	5 U	2 U	14.7	2 U	12.7	2.5 U	NA	16	5 U	32	5 U	5.2	6.5	NA	17	8	14	6.68	32	5.2
7610W	POTASSIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2700	NA	NA	NA	NA	1	2700	2700	2700	2700

All results in ug/l (ppb).
All undetected results listed at
half detection limit.
[T] - unfiltered sample (total).
[D] - filtered sample (dissolved).
U - Undetected.
J - Estimated value.
R - Rejected value.
NA - Not analyzed.

TABLE 4-13
CRANSTON SITE
WARWICK AREA
SWMU-5
ORGANIC GROUNDWATER DATA

	PHASE / ROUND	IB-1	IB-2	IB-3	IB-1	IB-2	IB-3	II-1	IB-1	IB-2	IB-3	II-1	II-1	II-1	II-2	II-1	II-2	II-2	SWMU-5 SUMMARY				
	SUB AREA	SWMU5	SWMU5	SWMU5	SWMU5	SWMU5	SWMU5	SWMU5	SWMU5	SWMU5	SWMU5	SWMU5	SWMU5	SWMU5	SWMU-5	SWMU5	SWMU-5	SWMU-5					
	SAMPLE ID	RW-3*IB-1	RW-3*IB-2	RW-3*IB-3	MW-6S*IB-1	MW-6S*IB-2	MW-6S*IB-3	MW-6S*II-1	MW-11S*IB-1	MW-11S*IB-2	MW-11S*IB-3	MW-11S*II-1	MW-DUP1*II-1(MW11S)	MW-11D*II-1	MW-11D*II-2	MW-26S*II-1	MW-26S*II-2	MW-DUP1*II-2(MW26S)					
	COLLECT DATE	1/7/91	4/16/91	9/10/91	1/7/91	4/15/91	9/10/91	8/25/93	1/8/91	4/18/91	9/10/91	8/25/93	8/25/93	8/24/93	5/3/94	8/24/93	5/3/94	5/3/94					
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
VOLATILE ORGANICS																							
	HALOGENATED																						
8240W	1,1-DICHLOROETHANE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.1 J	2.5 U	12.5 U	12.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1	2.1	3.65	2.1	2.1
8240W	CHLOROBENZENE	2.5 U	2.5 U	2.5 U	1.8 J	1.1 J	2.5 U	2.5 U	3500	780 J	390	590	670	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	7	848	350	3500	1.1
8240W	TETRACHLOROETHENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	8.4	4 J	12.5 U	12.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2	6.2	4.11	8.4	4
8240W	TRICHLOROETHENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2 J	2.5 U	12.5 U	12.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1	2	3.65	2	2
	AROMATICS																						
8240W	BENZENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	35	13 J	12.5 U	12.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2	24	6.21	35	13
8240W	ETHYLBENZENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.7 J	2.5 U	12.5 U	12.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1	2.7	3.69	2.7	2.7
8240W	M&P-XYLENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1.8 J	2.5 U	12500 U	12.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1	1.8	738	1.8	1.8
8240W	O-XYLENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	0.8 J	2.5 U	12.5 U	12.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1	0.8	3.58	0.8	0.8
8240W	TOLUENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	31	25 U	12.5 U	12.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1	31	6.68	31	31
	OTHER VOLATILE ORGANICS																						
8240W	CARBON DISULFIDE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	12.5 U	920	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1	920	57.1	920	920
SEMI-VOLATILE ORGANICS																							
	BASE NEUTRALS																						
	PAHs																						
8270W	FLUORANTHENE	1 J	1 J	5 U	5 U	4.75 U	5 U	5 U	5 U	4.8 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2	1	4.5	1	1
8270W	NAPHTHALENE	5 U	4.75 U	5 U	5 U	4.75 U	5 U	5 U	4 J	1 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2	2.5	4.68	4	1
8270W	PYRENE	2 J	0.94 J	0.6 J	5 U	4.75 U	5 U	5 U	5 U	4.8 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	3	1.18	4.3	2	0.6
	PHTHALATES																						
8270W	DI-N-OCTYLPHTHALATE	1 J	4.75 U	5 U	5 U	4.75 U	5 U	5 U	1 J	4.8 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2	1	4.49	1	1
8270W	DIETHYLPHTHALATE	5 U	4.75 U	5 U	5 U	4.75 U	0.7 J	5 U	5 U	4.8 U	2.3 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2	1.5	4.55	2.3	0.7
	HALOGENATED																						
8270W	4-CHLOROANILINE	5 U	4.75 U	5 U	5 U	4.75 U	5 U	10 U	21	5 J	0.9 J	1.8 J	10 U	10 U	10 U	10 U	10 U	10 U	4	7.18	7.54	21	0.9
8270W	2,2'-OXYBIS(1-CHLOROPROPANE)	5 U	4.75 U	5 U	5 U	4.75 U	5 U	5 U	28	4.8 U	5 U	7 J	7.3 J	5 U	5 U	5 U	5 U	5 U	3	14.1	6.56	28	7
8270W	BIS(2-CHLOROETHYL)ETHER	5 U	4.75 U	5 U	5 U	4.75 U	5 U	5 U	5 U	2 J	0.7 J	1.4 J	1.6 J	5 U	5 U	5 U	5 U	5 U	4	1.43	4.13	2	0.7
	OTHER BASE NEUTRALS																						
8270W	ANILINE	5 U	4.75 U	25 U	5 U	4.75 U	25 U	25 U	7 J	2 J	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	2	4.5	17.9	7	2
8270W	O-TOLUIDINE	5 U	4.75 U	5 U	5 U	4.75 U	5 U	5 U	6 J	4.8 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1	6	5.02	6	6
	ACID EXTRACTABLES																						
	PHENOLS																						
8270W	2-CHLOROPHENOL	5 U	4.75 U	5 U	5 U	4.75 U	5 U	5 U	11 J	6 J	1.7 J	4 J	3.9 J	5 U	5 U	5 U	5 U	5 U	5	5.32	5.06	11	1.7
8270W	PHENOL	5 U	4.75 U	5 U	5 U	4.75 U	5 U	5 U	5 U	3 J	1.5 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2	2.25	4.65	3	1.5
FINGERPRINT COMPOUNDS																							
8270W	PROPAZINE	25 U	24 U	100 U	35 J	15 J	16 J	10 U	7 J	24 U	100 U	19 J	22	10 U	10 U	10 U	10 U	10 U	6	19	26.3	35	7
8270W	TINUVIN 327	25 U	24 U	50 U	3 J	24 U	50 U	NA	4 J	1 J	0.8 J	NA	NA	NA	NA	NA	NA	NA	4	2.2	20.2	4	0.8
ORGANOCHLORINE PESTICIDES																							
8080W	ALDRIN	0.00475 U	0.00475 U	0.025 U	0.028	0.00485 U	0.025 U	0.025 U	0.089	0.0475 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	2	0.0585	0.0267	0.089	0.028
8080W	ALPHA-BHC	0.00475 U	0.00475 U	0.025 U	0.005 U	0.00485 U	0.025 U	0.025 U	0.037 J	0.0475 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	1	0.037	0.0223	0.037	0.037
8080W	DELTA-BHC	0.017	0.00475 U	0.025 U	0.005 U	0.00485 U	0.025 U	0.025 U	0.01 U	0.0475 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	1	0.017	0.0214	0.017	0.017
8080W	GAMMA-BHC	0.00475 U	0.00475 U	0.025 U	0.005 U	0.14 J	0.025 U	0.025 U	0.01 U	0.0475 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	1	0.14	0.0286	0.14	0.14
8080W	GAMMA-CHLORDANE	0.00475 U	0.00475 U	0.05 U	0.016	0.00485 U	0.05 U	0.025 U	0.01 U	0.0475 U	0.05 U	0.025 U	0.025 U	0.052 J	0.025 U	0.025 U	0.025 U	0.025 U	2	0.034	0.0273	0.052	0.016
ORGANOPHOSPHOROUS PESTICIDES																							
8140W	DIMETHOATE	0.5 U	0.475 U	2 U	0.44 J	0.475 U	2 U	5 U	0.5 U	0.475 U	2 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1	0.44	2.87	0.44	0.44
HERBICIDES																							
8150W	2,4,5-T	0.1 U	0.095 U	0.15 U	0.1 U	0.095 U	0.15 U	0.25 U	0.11 J	0.095 U	0.15 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	1	0.11	0.179	0.11	0.11
8150W	DINOSEB	0.075 U	0.07 U	NA	0.075 U	0.07 U	NA	NA	R	0.04 J	NA	NA	NA	NA	NA	NA	NA	NA	1	0.04	0.066	0.04	0.04
CHLORINATED DIOXINS AND FURANS																							
SOWZW	OCDD	NA	NA	R	NA	NA	R	0.0012 J	NA	NA	R	0.0008 U	0.0007 U	0.00105 U	0.0007 U	0.0023 U	0.0007 U	0.00075 U	1	0.0012	0.001	0.0012	0.0012

All results in ug/l (ppb).
All undetected results listed at half detection limit.
U - Undetected.
J - Estimated value.
R - Rejected value.
NA - Not analyzed.
F - Estimated maximum concentration.

TABLE 4-4
CRANSTON SITE
WARWICK AREA
SWMU-16
ORGANIC GROUNDWATER DATA

PHASE / ROUND	II-1	IB-2	IB-1	IB-3	IB-2	IB-1	IB-3	II-2	II-1	SWMU-16 SUMMARY				
SUB AREA	SWMU16	AAOI16	AAOI16	AAOI16	AAOI16	AAOI16	AAOI16	SWMU-16	SWMU16					
SAMPLE ID	MW-17S*II-1	MW-17S*IB-2	MW-17S*IB-1	MW-17S*IB-3	MW-17D*IB-2	MW-17D*IB-1	MW-17D*IB-3	MW-32S*II-2	MW-32S*II-1	Frequency	Average	Average	Maximum	Minimum
COLLECT DATE	8/25/93	4/15/91	1/8/91	9/10/91	4/15/91	1/8/91	9/10/91	5/2/94	8/24/93	of	Detected	Reported	Detected	Detected
	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Detection		(with 1/2 detection limit)		
VOLATILE ORGANICS														
HALOGENATED														
8240W 1,1,1-TRICHLOROETHANE	2.5 U	23	34	2.9 J	2.5 U	2.5 U	2.5 U	11	5.4	5	15.3	9.59	34	2.9
8240W 1,1-DICHLOROETHANE	2.5 U	2.5 U	4.1 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1	4.1	2.68	4.1	4.1
8240W TRICHLOROETHENE	2.5 U	1.3 J	2.1 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2	1.7	2.32	2.1	1.3
AROMATICS														
8240W TOLUENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2 J	2.5 U	2.5 U	2.5 U	1	2	2.44	2	2
8270W DI-N-BUTYLPHTHALATE	5 U	4.75 U	5 U	5 U	4.75 U	5 U	0.7 J	5 U	5 U	1	0.7	4.47	0.7	0.7
ORGANOCHLORINE PESTICIDES														
8080W 4,4'-DDT	0.05 U	0.0095 U	0.0095 U	0.05 U	0.0095 U	0.023	0.05 U	0.05 U	0.05 U	1	0.023	0.0335	0.023	0.023
8080W ALDRIN	0.025 U	0.00475 U	0.0048 U	0.025 U	0.00485 U	0.025	0.025 U	0.025 U	0.025 U	1	0.025	0.0183	0.025	0.025
8080W ALPHA-BHC	0.025 U	0.00475 U	0.0048 U	0.025 U	0.00485 U	0.015	0.025 U	0.025 U	0.025 U	1	0.015	0.0172	0.015	0.015
8080W GAMMA-BHC	0.025 U	0.00475 U	0.0048 U	0.025 U	0.00485 U	0.018	0.025 U	0.025 U	0.025 U	1	0.018	0.0175	0.018	0.018

All results in ug/l (ppb).

All undetected results listed at half detection limit.

U - Undetected.

J - Estimated value.

R - Rejected value.

NA - Not analyzed.

TABLE 4-15
CRANSTON SITE
WARWICK AREA
SWMU-5
INORGANIC GROUNDWATER DATA

TOTAL METALS

	PHASE / ROUND	IB-1	IB-2	IB-3	IB-3	IB-1	IB-2	IB-3	II-1	IB-1	IB-2	IB-3	II-1	II-1	II-1	II-2	II-1	II-2	II-2	SWMU-5 SUMMARY - TOTAL				
	SUB AREA	SWMU5/RW3	SWMU5/RW3	SWMU5/RW3	SWMU5/RW3	SWMU5/MW6S	SWMU5/MW6S	SWMU5/MW6S	SWMU5/MW6S	SWMU5/MW11S	SWMU5/MW11S	SWMU5/MW11S	SWMU5/MW11D	SWMU5/MW11S	SWMU5/MW11S	SWMU-5/MW11D	SWMU5/MW26S	SWMU-5/MW26S	SWMU-5/MW26S					
	SAMPLE ID	RW-3*IB-1 [T]	RW-3*IB-2 [T]	RW-3*IB-3[T]	RW-3*IB-3[T]	MW-6S*IB-1 [T]	MW-6S*IB-2 [T]	MW-6S*IB-3[T]	MW-6S*II-1[T]	MW-11S [T]	MW-11S*IB-2 [T]	MW-11S*IB-3[T]	MW-11D*II-1[T]	MW-11S*II-1[T]	MW-DUP1*II-1[T]	MW-11D*II-2[T]	MW-26S*II-1[T]	MW-26S*II-2[T]	MW-DUP1*II-2[T]					
	COLLECT DATE	1/7/91	4/16/91	9/10/91	9/11/91	1/7/91	4/15/91	9/10/91	8/25/93	1/8/91	4/18/91	9/10/91	8/24/93	8/25/93	8/25/93	5/3/94	8/24/93	5/3/94	5/3/94	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q					
6010W	BARIUM	200	298	260	NA	81	45.6	46	68	31	33.5	17	55	39	38	50.1	82	191	144	17	98.8	98.8	298	17
6010W	BERYLLIUM	1 U	1 U	2.5 U	NA	1 U	2.4	2.5 U	2.5 U	1 U	2.8	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	21 J	7.3 J	4	8.38	3.53	21	2.4
6010W	CADMIUM	2.5 U	2.5 U	2.5 U	NA	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	17.8 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	8 J	2.5 U	2	12.9	3.72	17.8	8
6010W	CALCIUM	203000 J	328000	NA	390000	34400 J	33000	33000	28000	30700 J	23700	20000	47000	24000	NA	46000	19000	19000	19000	16	81100	81100	390000	19000
6010W	CHROMIUM	16 U	10.8	51	NA	10 U	5 U	5 U	12	5 U	41.4 J	11	12	18	18	58.9 J	37	62.3 J	36.7 J	12	30.8	24.1	62.3	10.8
6010W	COBALT	5 U	5 U	5 U	NA	5 U	5 U	5 U	5 U	5 U	10.7	5 U	5 U	5 U	5 U	5 U	20	61.7	32.3	4	31.2	11.2	61.7	10.7
6010W	COPPER	10 U	10 U	12.5 U	NA	10 U	10 U	12.5 U	12.5 U	10 U	49.6	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	26	53.5	27.4	4	39.1	18	53.5	26
6010W	IRON	698 J	200	NA	3800	20600 J	9650	4800	11000	14600 J	26500	12000	3500	35000	NA	2800	11000	4500	3600	16	10300	10300	35000	200
6010W	MAGNESIUM	500 U	500 U	NA	10000	3600	2310	2500	2000	3310	3500	2900	7300	4200	NA	7400	4500	3100	3100	14	4270	3800	10000	2000
6010W	MANGANESE	15	5 U	NA	280	427	449	230	650	475	302	240	430	400	NA	460	570	600	540	15	405	380	650	15
6010W	NICKEL	20	10 U	20 U	NA	10 U	10 U	20 U	20 U	10 U	10 U	20 U	20 U	20 U	20 U	20 U	20 U	61.3	20 U	2	40.7	19.5	61.3	20
6010W	POTASSIUM	11000	11700	NA	9800	6230	5280	8300	5500	3380	3060	3300	3000	3800	NA	NA	5500	NA	NA	13	6140	6140	11700	3000
6010W	SILVER	5 U	5 U	5 U	NA	5 U	5 U	5 U	5 U	5 U	10.5 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1	10.5	5.32	10.5	10.5
6010W	SODIUM	61800	34500	NA	37000	14900	13000	12000	10000	11700	12300	8700	19000	11000	NA	18000	11000	8600	8600	16	18300	18300	61800	8600
6010W	VANADIUM	10 U	10 U	5 U	NA	10 U	10 U	5 U	5 U	10 U	10 U	5 U	5 U	5 U	5 U	5 U	28	88.7	46.3	3	54.3	15.5	88.7	28
6010W	ZINC	10 U	10 U	31 U	NA	291 J	185	50 U	170 J	1960 J	2160	700 J	64 J	1200 J	1300 J	47.4	180 J	416	318	13	692	535	2160	47.4
7060W	ARSENIC	4.4	4.6	2.5 U	NA	5.7	2 U	2.5 U	5 U	10.6	24.6 J	13	17	50	54	19.4 J	27	70 J	49.2 J	13	26.9	21.3	70	4.4
7421W	LEAD	3.4 U	5.7	2.5 U	NA	14.9 U	1.5 U	2.5 U	2.5 U	6.75 U	17 J	5	8.5	9.9	10	7.6 J	18	60.7 J	35.9 J	10	17.8	12.5	60.7	5
7610W	POTASSIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2800	NA	17000	5900	3	8570	8570	17000	2800

DISSOLVED METALS

	PHASE / ROUND	IB-1	IB-2	IB-3	IB-3	IB-1	IB-2	IB-3	II-1	IB-1	IB-2	IB-3	II-1	II-1	II-1	II-2	II-1	II-2	II-2	SWMU-5 SUMMARY - DISSOLVED				
	SUB AREA	SWMU5/RW3	SWMU5/RW3	SWMU5/RW3	SWMU5/RW3	SWMU5/MW6S	SWMU5/MW6S	SWMU5/MW6S	SWMU5/MW6S	SWMU5/MW11S	SWMU5/MW11S	SWMU5/MW11S	SWMU5/MW11D	SWMU5/MW11S	SWMU5/MW11S	SWMU-5/MW11D	SWMU5/MW26S	SWMU-5/MW26S	SWMU-5/MW26S					
	SAMPLE ID	RW-3*IB-1 [D]	RW-3*IB-2 [D]	RW-3*IB-3[D]	RW-3*IB-3[D]	MW-6S*IB-1 [D]	MW-6S*IB-2 [D]	MW-6S*IB-3[D]	MW-6S*II-1[D]	MW-11S [D]	MW-11S*IB-2 [D]	MW-11S*IB-3[D]	MW-11D*II-1[D]	MW-11S*II-1[D]	MW-DUP1*II-1[D]	MW-11D*II-2[D]	MW-26S*II-1[D]	MW-26S*II-2[D]	MW-DUP1*II-2[D]					
	COLLECT DATE	1/7/91	4/16/91	9/10/91	9/11/91	1/7/91	4/15/91	9/10/91	8/25/93	1/8/91	4/18/91	9/10/91	8/24/93	8/25/93	8/25/93	5/3/94	8/24/93	5/3/94	5/3/94	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q					
6010W	BARIUM	190	305	260	NA	39	34.6	44	56	20	18.6	13	24	13	14	32.9	18	5 U	13.6	16	68.5	64.7	305	13
6010W	BERYLLIUM	1 U	1 U	2.5 U	NA	1 U	1 U	2.5 U	2.5 U	1 U	3.5	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1	3.5	2.12	3.5	3.5
6010W	CADMIUM	2.5 U	2.5 U	17	NA	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	11.6 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2	14.3	3.89	17	11.6
6010W	CALCIUM	190000 J	332000	NA	430000	34300 J	31300	31000	27000	30300 J	24900	19000	44000	22000	NA	43000	19000	16000	16000	16	81900	81900	430000	16000
6010W	CHROMIUM	5 U	5 U	5 U	NA	5 U	5 U	5 U	5 U	5 U	12.3	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1	12.3	5.43	12.3	12.3
6010W	COBALT	5 U	5 U	5 U	NA	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0		5		
6010W	COPPER	10 U	10 U	12.5 U	NA	10 U	10 U	12.5 U	12.5 U	10 U	10 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	0		11.6		
6010W	IRON	21.5 U	20 U	NA	3.25 U	5040 J	5700	NA	4700	5380 J	3100	1600	10	1800	NA	20	23	9.5 U	9.5 U	10	2740	1830	5700	10
6010W	MAGNESIUM	500 U	500 U	NA	12 U	2520	2170	2300	1900	2960	3050	2700	6400	3100	NA	6600	3700	2500	2500	13	3260	2710	6600	1900
6010W	MANGANESE	5 U	5 U	NA	0.75 U	343	424	NA	630	456	281	230	310	310	NA	340	120	16	16	12	290	232	630	16
6010W	NICKEL	10 U	10 U	20 U	NA	10 U	10 U	20 U	20 U	10 U	10 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	0		16.5		
6010W	POTASSIUM	11100	11800 J	NA	10000	5590	4970 J	NA	5300	3250	3140	3400	2600	3000	NA	NA	3500	NA	NA	12	5640	5640	11800	2600
6010W	SILVER	5 U	5 U	5 U	NA	5 U	5 U	5 U	5 U	5 U	14.1 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1	14.1	5.54	14.1	14.1
6010W	SODIUM	61300	34600	NA	27000	14200	12700	NA	9900	9900	11700	10000	18000	10000	NA	17000	11000	9300	8200	15	17700	17700	61300	8200
6010W	VANADIUM	10 U	10 U	5 U	NA	10 U	10 U	5 U	5 U	10 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0		6.76		
6010W	ZINC	10 U	10 U	10 U	NA	93 J	144 J	93	140	1520 J	1530 J	490	10 U	810	840	10 U	31	10 U	61.2 J	11	523	342	1530	31
7060W	ARSENIC	2 U	2 U	2.5 U	NA	2 U	2 U	2.5 U	5 U	2 U	2 U	2.5 U	16	5 U	5 U	16.1	5 U	5 U	5 U	2	16.1	4.8	16.1	16
7421W	LEAD	1.85 U	3.4	2.5 U	NA	1.85 U	1.5 U	2.5 U	2.5 U	1.5 U	1.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	1	3.4	2.3	3.4	3.4
7610W	POTASSIUM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2200	NA	2700	2600	3	2500	2500	2700	2200

All results in ug/l (ppb).
All undetected results listed at half detection limit.
[T] - unfiltered sample (total).
[D] - filtered sample (dissolved).
U - Undetected.
J - Estimated value.
R - Rejected value.
NA - Not analyzed.

TABLE
CRANSTON SITE
WARWICK AREA
SWMU-16
INORGANIC GROUNDWATER DATA

TOTAL METALS

	PHASE / ROUND	IB-1	IB-1	IB-2	IB-2	IB-3	IB-3	II-1	II-1	II-2	SWMU-16 SUMMARY - TOTAL				
	SUB AREA	AAOI16/MW17D	AAOI16/MW17S	AAOI16/MW17D	AAOI16/MW17S	AAOI16/MW17D	AAOI16/MW17S	SWMU16/MW17S	SWMU16/MW32S	SWMU-16/MW32S					
	SAMPLE ID	MW-17D [T]	MW-17S [T]	MW-17D*IB-2 [T]	MW-17S*IB-2 [T]	MW-17D*IB-3[T]	MW-17S*IB-3[T]	MW-17S*II-1[T]	MW-32S*II-1[T]	MW-32S*II-2[T]					
	COLLECT DATE	1/8/91	1/8/91	4/15/91	4/15/91	9/10/91	9/10/91	8/25/93	8/24/93	5/2/94					
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
6010W	BARIUM	44	138	75.7	70.2	96	99	160	280	51.6	9	113	113	280	44
6010W	BERYLLIUM	1 U	1 U	1 U	1 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	0		1.83		
6010W	CADMIUM	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	0		2.5		
6010W	CALCIUM	35100 J	20600 J	45500	17700	48000	18000	18000	22000	14000	9	26500	26500	48000	14000
6010W	CHROMIUM	5 U	5 U	12.8	19.2	17	25	38	39	5 U	6	25.2	18.4	39	12.8
6010W	COBALT	5 U	10	5 U	5 U	11	11	22	33	5 U	5	17.4	11.9	33	10
6010W	COPPER	10 U	43	23	10 U	12.5 U	12.5 U	30	30	12.5 U	4	31.5	20.4	43	23
6010W	IRON	4530 J	52400 J	14600	22400	4300	22000	7800	46000	11000	9	20600	20600	52400	4300
6010W	MAGNESIUM	4510	5740	8710	3820	7000	3600	3000	8100	1800	9	5140	5140	8710	1800
6010W	MANGANESE	273	1330	902	720	930	820	640	5700	1000	9	1370	1370	5700	273
6010W	NICKEL	10 U	10 U	10 U	10 U	20 U	20 U	20 U	20 U	20 U	0		15.6		
6010W	POTASSIUM	15400	17000	3290	6720	2600	6600	5200	7700	NA	8	8060	8060	17000	2600
6010W	SILVER	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0		5		
6010W	SODIUM	18100	24500	15100	19800	14000	20000	22000	23000	9100	9	18400	18400	24500	9100
6010W	VANADIUM	10 U	22	10 U	10 U	22	14	36	39	5 U	5	26.6	18.7	39	14
6010W	ZINC	31 J	82 J	358	125	38.5 U	55 U	110 J	210 J	112	7	147	125	358	31
7060W	ARSENIC	11.2	44.9	16.5	23.6	22	38	100	39	5 U	8	36.9	33.4	100	11.2
7421W	LEAD	4.1 U	9 U	7.9	8.3	7.2	8.6	20	21	5.4 J	7	11.2	10.2	21	5.4
7610W	POTASSIUM	NA	NA	NA	NA	NA	NA	NA	NA	4200	1	4200	4200	4200	4200

DISSOLVED METALS

	PHASE / ROUND	IB-1	IB-1	IB-2	IB-2	IB-3	IB-3	II-1	II-1	II-2	SWMU-16 SUMMARY - DISSOLVED				
	SUB AREA	AAOI16/MW17D	AAOI16/MW17S	AAOI16/MW17D	AAOI16/MW17S	AAOI16/MW17D	AAOI16/MW17S	SWMU16/MW17S	SWMU16/MW32S	SWMU-16/MW32S					
	SAMPLE ID	MW-17D [D]	MW-17S [D]	MW-17D*IB-2 [D]	MW-17S*IB-2 [D]	MW-17D*IB-3[D]	MW-17S*IB-3[D]	MW-17S*II-1[D]	MW-32S*II-1[D]	MW-32S*II-2[D]					
	COLLECT DATE	1/8/91	1/8/91	4/15/91	4/15/91	9/10/91	9/10/91	8/25/93	8/24/93	5/2/94					
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
6010W	BARIUM	34	58	39.9	37.6	45	38	33	30	5 U	8	39.4	35.6	58	30
6010W	BERYLLIUM	1 U	1 U	1 U	1 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	0		1.83		
6010W	CADMIUM	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	0		2.5		
6010W	CALCIUM	33500 J	16700 J	42600	17000	42000	17000	17000	19000	13000	9	24200	24200	42600	13000
6010W	CHROMIUM	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0		5		
6010W	COBALT	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0		5		
6010W	COPPER	10 U	10 U	10 U	10 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	0		11.4		
6010W	IRON	20 U	20 U	53.8	52.8	3.25 U	3.25 U	35	8.4	9.5 U	4	37.5	22.9	53.8	8.4
6010W	MAGNESIUM	3550	2250	5970	2440	6000	2400	2200	4200	960	9	3330	3330	6000	960
6010W	MANGANESE	149	581	600	417	750	390	260	450	3.1	9	400	400	750	3.1
6010W	NICKEL	10 U	10 U	10 U	10 U	20 U	20 U	20 U	20 U	20 U	0		15.6		
6010W	POTASSIUM	17100	13800	1500 U	5550 J	2200	6400	4300	3500	NA	7	7550	6790	17100	2200
6010W	SILVER	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0		5		
6010W	SODIUM	16900	21900	13400	19100	15000	22000	21000	22000	8600	9	17800	17800	22000	8600
6010W	VANADIUM	10 U	10 U	10 U	10 U	5 U	5 U	5 U	10 U	5 U	0		7.22		
6010W	ZINC	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	83.6 J	1	83.6	18.2	83.6	83.6
7060W	ARSENIC	2 U	2 U	10.3	2 U	20	2.5 U	5 U	5 U	5 U	2	15.2	5.98	20	10.3
7421W	LEAD	1.9 U	1.6 U	1.5 U	1.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	0		2.11		
7610W	POTASSIUM	NA	NA	NA	NA	NA	NA	NA	NA	2300	1	2300	2300	2300	2300

All results in ug/l (ppb).
All undetected results listed at half detection limit.
[T] - unfiltered sample (total).
[D] - filtered sample (dissolved).
U - Undetected.
J - Estimated value.
R - Rejected value.
NA - Not analyzed.

s:\87s4660\groundwa\warwick\l_16GTHR.XLS

TABLE 4-17
SOIL
PHASE II SAMPLE SUMMARY

PH2SOILT.XLS
7/28/95 4:35 PM

	AREA	PRODUCTION AREA						
	PHASE - ROUND	II-1	II-2	II-1	II-1	II-1	II-1	II-1
	AREA - SUB_AREA	PROD-AOC13	PROD-AOC13	PROD-AOI15	PROD-SMU2	PROD-SMU3	PROD-SMU7	PROD-SMU8
ANALYTE GROUP	METHOD	Samples	Samples	Samples	Samples	Samples	Samples	Samples
ICP METALS	6010S	2	NA	2	2	2	3	2
ANTIMONY	7041S	NA	NA	NA	NA	NA	NA	NA
ARSENIC	7060S	2	1	2	2	2	3	2
LEAD	7421S	NA	NA	2	2	2	3	2
MERCURY	747ZS	2	NA	2	NA	2	3	2
SELENIUM	7740S	NA	NA	NA	NA	2	3	NA
THALLIUM	7841S	NA	NA	NA	NA	2	3	NA
HERBICIDES	8015S	NA	NA	NA	NA	NA	NA	NA
HERBICIDES	815ZS	NA	NA	2	2	NA	NA	3
ORGANOCHLORINE PESTICIDES/PCB's	8080S	56	9	2	6	11	12	11
ORGANOPHOSPHORUS PESTICIDES	814ZS	2	NA	2	6	11	12	11
VOLATILE ORGANICS	8240S	2	NA	2	2	11	12	11
SEMIVOLATILE ORGANICS	8270S	2	NA	2	6	11	12	11
CYANIDES	9010S	2	NA	2	NA	2	12	2
DIOXINS/FURANS	SOWZS	NA	NA	2	2	2	3	2

TABLE 4-17
SOIL
PHASE II SAMPLE SUMMARY

PH2SOILT.XLS
7/28/95 4:35 PM

	AREA	WARWICK AREA			
	PHASE - ROUND	II-1	II-1	II-2	II-1
	AREA - SUB_AREA	WARWK-SMU16	WARWK-SMU5	WARWK-SMU5	WARWK-SMU9
ANALYTE GROUP	METHOD	Samples	Samples	Samples	Samples
ICP METALS	6010S	3	12	NA	3
ANTIMONY	7041S	NA	12	NA	NA
ARSENIC	7060S	3	2	NA	3
LEAD	7421S	3	2	NA	3
MERCURY	747ZS	NA	12	NA	NA
SELENIUM	7740S	3	NA	NA	NA
THALLIUM	7841S	NA	NA	NA	NA
HERBICIDES	8015S	3	NA	NA	NA
HERBICIDES	815ZS	NA	12	NA	NA
ORGANOCHLORINE PESTICIDES/PCB's	8080S	9	12	5	3
ORGANOPHOSPHORUS PESTICIDES	814ZS	NA	12	NA	3
VOLATILE ORGANICS	8240S	9	12	NA	3
SEMIVOLATILE ORGANICS	8270S	NA	12	NA	3
CYANIDES	9010S	3	12	NA	NA
DIOXINS/FURANS	SOWZS	3	2	NA	3

TABLE 4-17
SOIL
PHASE II SAMPLE SUMMARY

	AREA	WASTE WATER TREATMENT AREA			OFF-SITE	
	PHASE - ROUND	II-1	II-1	II-2	II-1	II-1
	AREA - SUB_AREA	WWTA-SMU10	WWTA-SMU12	WWTA-SMU12	OFFST-BG	OFFST-OF
ANALYTE GROUP	METHOD	Samples	Samples	Samples	Samples	Samples
ICP METALS	6010S	5	11	NA	9	16
ANTIMONY	7041S	NA	NA	NA	NA	2
ARSENIC	7060S	5	3	NA	9	16
LEAD	7421S	5	3	NA	9	16
MERCURY	747ZS	NA	2	NA	9	16
SELENIUM	7740S	5	3	NA	9	16
THALLIUM	7841S	NA	NA	NA	9	16
HERBICIDES	8015S	5	NA	NA	NA	NA
HERBICIDES	815ZS	5	3	NA	9	16
ORGANOCHLORINE PESTICIDES/PCB's	8080S	5	11	3	9	16
ORGANOPHOSPHORUS PESTICIDES	814ZS	5	11	NA	9	16
VOLATILE ORGANICS	8240S	5	11	NA	9	16
SEMIVOLATILE ORGANICS	8270S	5	11	NA	9	16
CYANIDES	9010S	5	2	NA	9	16
DIOXINS/FURANS	SOWZS	5	2	NA	9	16

TABLE 4
CRANSTON SITE
BACKGROUND
SHALLOW SOIL
ORGANIC DATA

AREA/SUB AREA		BG/BGBP	BG/BGDGA	BG/BGWBGC	BG/BGWS	BG/BP	BG/BP	BG/BP	BG/ND	BG/ND	BG/PH	BG/PH	BG/WS	BG/WS
SAMPLE ID		SF-BG-BP*II-1	SF-BG-DGA*II-1	SF-BG-WBGC*II-1	SF-BG-WS*II-1	B-DUP6*II-1	SF-BG-BP*IB-1	SF-BG-BP*IB-2	SF-BG-ND*IB-1	SF-BG-ND*IB-2	SF-BG-PH*IB-1	SF-BG-PH*IB-2	SF-BG-WS*IB-1	SF-BG-WS*IB-2
SAMPLE DATE		8/9/93	7/27/93	7/28/93	8/9/93	1/0/00	12/3/90	3/21/91	12/3/90	3/21/91	12/3/90	3/21/91	12/3/90	3/21/91
DEPTH RANGE (ft)		.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
VOLATILE ORGANICS														
HALOGENATED														
8240S	CHLOROFORM	0.00285 U	0.0026 U	0.0027 U	0.0026 U	0.00295 U	0.06 U	0.065 U	0.06 U	0.032 J	0.055 U	0.06 U	0.06 U	0.06 U
8240S	METHYLENE CHLORIDE	0.00285 U	0.01 J	0.0027 U	0.0026 U	0.00295 U	0.12	2.35 U	0.064 J	0.19 U	0.058 J	0.55 U	0.078 J	0.11 U
8240S	TETRACHLOROETHENE	0.00285 U	0.011 J	0.0027 U	0.0026 U	0.00295 U	0.06 U	0.065 U	0.06 U	0.065 U	0.055 U	0.06 U	0.06 U	0.06 U
AROMATICS														
8240S	BENZENE	0.00285 U	0.0026 U	0.0027 U	0.0026 U	0.00295 U	0.06 U	0.043 J	0.06 U	0.065 U	0.055 U	0.06 U	0.06 U	0.06 U
8240S	M&P-XYLENE	0.00285 U	0.0026 U	0.0027 U	0.0026 U	0.00295 U	0.06 U	0.065 U	0.06 U	0.065 U	0.055 U	0.06 U	0.06 U	0.06 U
8240S	TOLUENE	0.00285 U	0.0026 U	0.0027 U	0.0026 U	0.00295 U	0.06 U	1.2 J	0.06 U	0.04 J	0.055 U	0.17 J	0.06 U	0.027 J
KETONE/ALDEHYDES														
8240S	2-BUTANONE	0.0145 U	0.013 U	0.0135 U	0.013 U	0.0145 U	0.115 U	0.13 U	0.12 U	0.17 J	0.105 U	0.12 U	0.115 U	0.12 U
8240S	ACETONE	0.0145 U	0.013 U	0.0135 U	0.013 U	0.0145 U	0.115 U	0.13 U	0.12 U	0.125 U	0.105 U	0.12 U	0.115 U	0.12 U
DIRECT INJECTION VOA														
824DS	1,4-DIOXANE	NA	NA	NA	NA	NA	6 U	6.5 U	6 U	6.5 U	5.5 U	6 U	5.5 U	6 U
SEMI-VOLATILE ORGANICS														
BASE NEUTRALS														
PAHs														
8270S	2-METHYLNAPHTHALENE	0.19 U	0.17 U	0.18 U	0.17 U	0.195 U	0.57 J	4.5 J	0.6 U	0.21 U	0.5 U	0.195 U	0.49 U	0.195 U
8270S	ACENAPHTHENE	0.19 U	0.031 J	0.18 U	0.17 U	0.195 U	0.82 J	5.4 J	0.063 J	0.051 J	0.5 U	0.195 U	0.49 U	0.195 U
8270S	ACENAPHTHYLENE	0.044 J	0.078 J	0.18 U	0.17 U	0.195 U	0.28 J	0.61 J	0.6 U	0.21 U	0.5 U	0.195 U	0.49 U	0.195 U
8270S	ANTHRACENE	0.081 J	0.11 J	0.18 U	0.17 U	0.036 J	4.2	20 J	0.18 J	0.15 J	0.041 J	0.195 U	0.49 U	0.195 U
8270S	BENZO(A)ANTHRACENE	0.28 J	0.56	0.125 U	0.12 U	0.12 J	6.6	28 J	0.82 J	0.67	0.32 J	0.195 U	0.49 U	0.195 U
8270S	BENZO(A)PYRENE	0.32 J	0.72 J	0.13 J	0.12 U	0.12 J	5	22 J	0.64 J	0.61	0.37 J	0.195 U	0.49 U	0.195 U
8270S	BENZO(B)FLUORANTHENE	0.4 J	1.3 J	0.2 J	0.026 J	0.15 J	8.2	36 J	1.4	0.91	0.6 J	0.195 U	0.49 U	0.195 U
8270S	BENZO(G,H,I)PERYLENE	0.22 J	0.38 J	0.08 J	0.17 U	0.195 U	3.7	12 J	0.52 J	0.4 J	0.49 J	0.195 U	0.49 U	0.195 U
8270S	BENZO(K)FLUORANTHENE	0.14 J	0.4 J	0.079 J	0.17 U	0.065 J	8.6	43 J	1.4	1.1	0.63 J	0.195 U	0.49 U	0.195 U
8270S	CHRYSENE	0.42 J	0.96	0.16 J	0.17 U	0.19 J	6.3	30 J	1.1 J	0.97	0.43 J	0.195 U	0.49 U	0.14 J
8270S	DIBENZ(A,H)ANTHRACENE	0.115 U	0.12 J	0.11 U	0.105 U	0.12 U	1 J	3.7 J	0.6 U	0.21 U	0.5 U	0.195 U	0.49 U	0.195 U
8270S	FLUORANTHENE	0.69 J	2	0.42	0.043 J	0.29 J	14	57 J	2.1	1.6	0.74 J	0.23 J	0.096 J	0.18 J
8270S	FLUORENE	0.19 U	0.053 J	0.18 U	0.17 U	0.195 U	1.7	9.4 J	0.1 J	0.088 J	0.5 U	0.195 U	0.49 U	0.195 U
8270S	INDENO(1,2,3-CD)PYRENE	0.23 J	0.37 J	0.11 U	0.105 U	0.078 J	4.6	14 J	0.79 J	0.31 J	0.57 J	0.195 U	0.49 U	0.195 U
8270S	NAPHTHALENE	0.19 U	0.17 U	0.18 U	0.17 U	0.195 U	0.88 J	7.3 J	0.041 J	0.023 J	0.5 U	0.195 U	0.49 U	0.195 U
8270S	PHENANTHRENE	0.4 J	1.1	0.18 J	0.17 U	0.17 J	12	69 J	1.7	1.3	0.42 J	0.12 J	0.052 J	0.081 J
8270S	PYRENE	0.63 J	1.9 J	0.32 J	0.038 J	0.28 J	12	56 J	1.9	1.5	0.61 J	0.21 J	0.1 J	0.2 J
PHTHALATES														
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	0.12 J	0.2 U	0.18 U	0.087 J	0.195 U	0.55 U	R	0.65 U	0.21 U	0.5 U	0.195 U	1.15 U	0.195 U
8270S	BUTYLBENZYLPHTHALATE	0.19 U	0.05 J	0.18 U	0.17 U	0.195 U	0.55 U	R	0.6 U	0.21 U	0.5 U	0.195 U	0.49 U	0.195 U
8270S	DI-N-OCTYLPHTHALATE	0.19 U	0.17 U	0.18 U	0.17 U	0.195 U	0.55 U	R	0.6 U	0.21 U	0.5 U	0.195 U	0.49 U	0.195 U
OTHER BASE NEUTRALS														
8270S	P-PHENYLENEDIAMINE	1 U	0.9 U	0.95 U	0.9 U	1 U	2.8 U	R	3 U	1.05 U	2.55 U	5.9	2.45 U	0.95 U
8270S	SAFROLE	0.19 U	0.17 U	0.042 J	0.17 U	0.195 U	0.55 U	R	0.6 U	0.21 U	0.5 U	0.195 U	0.49 U	0.195 U
ACID EXTRACTABLES														
PHENOLS														
8270S	3&4-METHYLPHENOL	0.19 U	0.17 U	0.18 U	0.17 U	0.195 U	NA	NA	NA	NA	NA	NA	NA	NA
PCBs														
8080S	PCB-1254	0.019 U	0.085 U	0.018 U	0.017 U	0.0195 U	0.011 U	0.0215 U	0.012 U	0.0042 U	0.01 U	0.00395 U	0.011 U	0.0039 U
ORGANOCHLORINE PESTICIDES														
8080S	4,4'-DDD	0.0019 U	1.1	0.0018 U	0.0017 U	0.00195 U	0.00055 U	0.00105 U	0.0006 U	0.00078	0.000495 U	0.0035	0.00055 U	0.0031
8080S	4,4'-DDE	0.0019 U	0.81	0.0018 U	0.0017 U	0.00195 U	0.00055 U	0.38	0.0006 U	0.00021 U	0.0011	0.012	0.025 J	0.025
8080S	4,4'-DDT	0.013 J	9.3	0.0018 U	0.0017 U	0.0065 J	0.0011 U	0.00215 U	0.0012 U	0.0041	0.001 U	0.013	0.028 J	0.024
8080S	ALDRIN	0.001 U	0.0044 U	0.0009 U	0.0009 U	0.001 U	0.00055 U	0.00105 U	0.0006 U	0.00021 U	0.000495 U	0.0002 U	0.00055 U	0.000195 U
8080S	ALPHA-CHLORDANE	0.0032 J	0.0044 U	0.0009 U	0.0009 U	0.001 U	0.00055 U	0.00105 U	0.0006 U	0.00021 U	0.000495 U	0.0002 U	0.00055 U	0.000195 U
8080S	BETA-BHC	0.001 U	0.0044 U	0.0009 U	0.0009 U	0.001 U	0.00055 U	0.26 J	0.0006 U	0.00021 U	0.000495 U	0.0002 U	0.00055 U	0.000195 U
8080S	CHLOROBENZILATE	0.01 U	0.044 U	0.009 U	0.009 U	0.01 U	NA	NA	NA	NA	NA	NA	NA	NA
8080S	DELTA-BHC	0.001 U	0.0044 U	0.0009 U	0.0009 U	0.001 U	0.00055 U	0.00105 U	0.0006 U	0.00021 U	0.000495 U	0.0002 U	0.00055 U	0.000195 U
8080S	DIELDRIN	0.0019 U	0.0085 U	0.0018 U	0.0017 U	0.00195 U	0.00055 U	0.00105 U	0.0006 U	0.0041	0.000495 U	0.0014	0.00055 U	0.000195 U
8080S	ENDOSULFAN I	0.001 U	0.0044 U	0.0009 U	0.0009 U	0.001 U	0.00055 U	0.00105 U	0.0006 U	0.00021 U	0.000495 U	0.0002 U	0.00055 U	0.000195 U
8080S	ENDOSULFAN SULFATE	0.0019 U	0.0085 U	0.0018 U	0.0017 U	0.00195 U	0.0028 U	0.0055 U	0.0061 J	0.00105 U	0.0025 U	0.001 U	0.00275 U	0.00095 U
8080S	ENDRIN	0.0019 U	0.0085 U	0.0018 U	0.0017 U	0.00195 U	0.00055 U	0.00105 U	0.0006 U	0.00021 U	0.000495 U	0.0002 U	0.00055 U	0.00027 J
8080S	ENDRIN ALDEHYDE	0.0019 U	0.0085 U	0.0018 U	0.0017 U	0.00195 U	0.0011 U	0.00215 U	0.0012 U	0.00042 U	0.001 U	0.000395 U	0.0011 U	0.001
8080S	GAMMA-BHC	0.001 U	0.0044 U	0.0009 U	0.0009 U	0.001 U	0.00055 U	0.00105 U	0.0006 U	0.00021 U	0.000495 U	0.0002 U	0.00055 U	0.000195 U
8080S	GAMMA-CHLORDANE	0.005 J	0.0044 U	0.0009 U	0.0009 U	0.001 U	0.00055 U	0.00105 U	0.0006 U	0.00021 U	0.000495 U	0.0002 U	0.00055 U	0.000195 U
8080S	HEPTACHLOR	0.001 U	0.0044 U	0.0009 U	0.0009 U	0.001 U	0.00055 U	0.00105 U	0.0006 U	0.00021 U	0.000495 U	0.0002 U	0.00055 U	0.000195 U
8080S	HEPTACHLOR EPOXIDE	0.001 U	0.0044 U	0.0009 U	0.0009 U	0.001 U	0.00055 U	0.00105 U	0.0006 U	0.00021 U	0.000495 U	0.0002 U	0.00055 U	0.000195 U
8080S	ISODRIN	0.0019 U	0.0085 U	0.0018 U	0.0017 U	0.00195 U	0.0032	0.00105 U	0.0006 U	0.00021 U	0.000495 U	0.0002 U	0.00055 U	0.000195 U
8080S	KEPONE	0.01 U	0.18 J	0.009 U	0.009 U	0.01 U	0.00055 U	0.00105 U	0.0006 U	0.055	0.000495 U	0.0002 U	0.00055 U	0.000195 U
8080S	METHOXYCHLOR	0.01 U	0.044 U	0.009 U	0.009 U	0.01 U	0.0028 U	0.0055 U	0.003 U	0.00105 U	0.0025 U	0.001 U	0.00275 U	0.00095 U
ORGANOPHOSPHORUS PESTICIDES														
8147S	DISULFOTON	0.075 U	0.07 U	0.07 U	0.07 U	0.075 U	0.055 U	0.0215 U	0.0024 J	0.021 U	0.05 U	0.02 U	0.055 U	0.0195 U
8147S	ETHYL PARATHION	0.019 U	0.017 U	0.018 U	0.017 U	0.0195 U	0.043 U	0.016 U	0.0041 J	0.016 U	0.038 U	0.015 U	0.0034 J	0.0145 U
8147S	METHYL PARATHION	0.01 U	0.009 U	0.009 U	0.009 U	0.01 U	0.0046 J	0.0032 U	0.0028 J	0.00315 U	0.0039 J	0.003 U	0.0044 J	0.00295 U
HERBICIDES														
8151S	2,4,5-T	0.01 U	0.009 U	0.009 U	0.009 U	0.01 U	0.0115 U	0.0043 U	0.0115 U	0.0042 U	0.01 U	0.00395 U	0.011 U	0.00385 U
8151S	2,4,5-TP (SILVEX)	0.01 U	0.009 U	0.009 U	0.009 U	0.01 U	0.01 U	0.00365 U	0.0095 U	0.0036 U	0.0085 U	0.00335 U	0.0095 U	0.0033 U
8151S	2,4-D	0.01 U	0.009 U	0.009 U	0.009 U	0.01 U	0.07 U	0.026 U	0.07 U	0.0255 U	0.06 U	0.0235 U	0.065 U	0.023 U
8151S	DINOSEB	NA	NA	NA	NA	NA	0.0085 U	0.0032 U	0.0085 U	0.00315 U	0.0075 U	0.0027 J	0.0085 U	0.0029 U
CHLORINATED DIOXINS AND FURANS														
SOWZS	1,2,3,4,6,7,8-HPCDD	0.000015 U	0.0000425 U	0.00008 U	0.000027 U	0.0000125 U	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	1,2,3,4,6,7,8-HPCDF	0.000014 U	0.00011 F	0.0000395 U	0.0000305 U	0.0000135 U	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	HPCDD	0.000015 U	0.0000425 U	0.00008 U	0.000027 U	0.0000125 U	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	HPCDF	0.000014 U	0.00015 F	0.0000395 U	0.0000305 U	0.0000135 U	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	OCDD	0.00013 U	0.00029 F	0.0012 J	0.00035 J	0.00009 U	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	OCDF	0.000029 U	0.00019 F	0.00006 U	0.000055 U	0.000026 U	NA	NA	NA	NA	NA	NA	NA	NA
8270S	DIBENZOFURAN	0.19 U	0.17 U	0.18 U	0.17 U	0.195 U	1.5	9.7 J	0.061 J	0.043 J	0.5 U	0.195 U	0.49 U	0.195 U

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration.

TABLE 4-1
CRANSTON SITE
BACKGROUND
SHALLOW SOIL
ORGANIC DATA

	AREA/SUB AREA	OF/APC		OF/BRP		OF/BS		OF/CGH		OF/EHS		OF/FF		OF/HMEH		OF/NAS		OF/PAEH		OF/PIP		OF/PVJHS		OF/RCR	
	SAMPLE ID	SF-OF-APC*II-1		SF-OF-BRF*II-1		SF-OF-BS*II-1		SF-OF-CGH*II-1		SF-OF-EHS*II-1		SF-OF-FF*II-1		SF-OF-HMEH*II-1		SF-OF-NAS*II-1		SF-OF-PAEH*II-1		SF-OF-PIP*II-1		SF-OF-PVJHS*II-1		SF-OF-RCR*II-1	
	SAMPLE DATE	8/4/93		7/28/93		7/28/93		7/29/93		8/4/93		7/27/93		7/29/93		8/4/93		7/28/93		8/4/93		7/28/93		7/28/93	
	DEPTH RANGE (ft)	.5 to 1		.5 to 1		.5 to 1		.5 to 1		.5 to 1		.5 to 1		.5 to 1		.5 to 1		.5 to 1		.5 to 1		.5 to 1		.5 to 1	
		Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
VOLATILE ORGANICS																									
	HALOGENATED																								
8240S	CHLOROFORM	0.0027	U	0.00255	U	0.0026	U	0.00275	U	0.0026	U	0.0033	U	0.00265	U	0.0026	U	0.0027	U	0.00275	U	0.0026	U	0.0026	U
8240S	*METHYLENE CHLORIDE*	0.0027	U	0.017		0.0026	U	0.00275	U	0.0026	U	0.012	J	0.00265	U	0.0026	U	0.0027	U	0.00275	U	0.0026	U	0.0083	
8240S	TETRACHLOROETHENE	0.0027	U	0.00255	U	0.0026	U	0.0077		0.0026	U	0.0033	U	0.00265	U	0.0026	U	0.0027	U	0.00275	U	0.0026	U	0.0026	U
	AROMATICS																								
8240S	BENZENE	0.0027	U	0.00255	U	0.0026	U	0.00275	U	0.0026	U	0.0033	U	0.00265	U	0.0026	U	0.0027	U	0.00275	U	0.0026	U	0.0026	U
8240S	M&P-XYLENE	0.0027	U	0.00255	U	0.0026	U	0.00275	U	0.0026	U	0.0033	U	0.00265	U	0.0026	U	0.0027	U	0.00275	U	0.0026	U	0.0082	
8240S	TOLUENE	0.0027	U	0.00255	U	0.0026	U	0.00275	U	0.0026	U	0.0033	U	0.00265	U	0.0026	U	0.0027	U	0.00275	U	0.0026	U	0.0026	U
	KETONE/ALDEHYDES																								
8240S	2-BUTANONE	0.0135	U	0.013	U	0.013	U	0.0135	U	0.013	U	0.0165	U	0.013	U	0.013	U	0.0135	U	0.0135	U	0.013	U	0.013	U
8240S	ACETONE	0.0135	U	0.013	U	0.013	U	0.0135	U	0.013	U	0.14	J	0.013	U	0.013	U	0.0135	U	0.0135	U	0.013	U	0.013	U
DIRECT INJECTION VOA																									
824DS	1,4-DIOXANE	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
SEMI-VOLATILE ORGANICS																									
	BASE NEUTRALS																								
	PAHs																								
8270S	2-METHYLNAPHTHALENE	0.18	U	0.031	J	0.054	J	0.18	J	0.17	U	0.215	U	0.175	U	0.17	U	0.18	U	0.18	U	0.17	U	0.17	U
8270S	ACENAPHTHENE	0.18	U	0.074	J	0.26	J	0.33	J	0.17	U	0.215	U	0.175	U	0.11	J	0.18	U	0.18	U	0.17	U	0.17	U
8270S	ACENAPHTHYLENE	0.098	J	0.062	J	0.32	J	1.4	J	0.17	U	0.215	U	0.175	U	0.056	J	0.063	J	0.18	U	0.17	U	0.17	U
8270S	ANTHRACENE	0.12	J	0.12	J	0.26	J	3.3	J	0.029	J	0.215	U	0.175	U	0.3	J	0.14	J	0.18	U	0.17	U	0.17	U
8270S	BENZO(A)ANTHRACENE	0.69	J	0.49		1.1		9.3	J	0.12	U	0.15	U	0.12	U	0.91		0.6		0.125	U	0.12	U	0.12	U
8270S	BENZO(A)PYRENE	0.65	J	0.55	J	1.2		7.8	J	0.11	J	0.15	U	0.061	J	0.86		0.55		0.125	U	0.061	J	0.12	U
8270S	BENZO(B)FLUORANTHENE	0.9	J	0.94	J	1.7		9.5	J	0.17	J	0.033	J	0.12	U	1.2		0.83		0.027	J	0.076	J	0.045	J
8270S	BENZO(G,H,I)PERYLENE	0.36	J	0.34	J	0.84		3.7	J	0.065	J	0.215	U	0.175	U	0.45		0.31		0.18	U	0.17	U	0.17	U
8270S	BENZO(K)FLUORANTHENE	0.33	J	0.36	J	0.66		2.6	J	0.053	J	0.15	U	0.047	J	0.5		0.31		0.125	U	0.12	U	0.12	U
8270S	CHRYSENE	0.71	J	0.71		1.1		8.1	J	0.13	J	0.215	U	0.076	J	0.93		0.69		0.18	U	0.07	J	0.039	J
8270S	DIBENZ(A,H)ANTHRACENE	0.11	J	0.076	J	0.105	U	0.89	J	0.105	U	0.13	U	0.105	U	0.14	J	0.094	J	0.11	U	0.105	U	0.105	U
8270S	FLUORANTHENE	1.4	J	1.6		1.9		1.5	J	0.27	J	0.215	U	0.14	J	2.2		1.7		0.04	J	0.17	J	0.1	J
8270S	FLUORENE	0.042	J	0.1	J	0.059	J	1	J	0.17	U	0.215	U	0.175	U	0.14	J	0.054	J	0.18	U	0.17	U	0.17	U
8270S	INDENO(1,2,3-CD)PYRENE	0.39	J	0.29	J	0.91		3.9	J	0.068	J	0.13	U	0.039	J	0.5		0.36		0.11	U	0.043	J	0.105	U
8270S	NAPHTHALENE	0.18	U	0.055	J	0.12	J	0.34	J	0.17	U	0.215	U	0.175	U	0.044	J	0.18	U	0.18	U	0.17	U	0.17	U
8270S	PHENANTHRENE	0.61	J	1.3		0.88		19	J	0.17	J	0.215	U	0.075	J	1.4		0.87		0.18	U	0.09	J	0.044	J
8270S	PYRENE	1.3	J	2		1.8		21		0.26	J	0.215	U	0.14	J	1.9		1.2		0.039	J	0.12	J	0.064	J
	PHTHALATES																								
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	0.18	U	11		0.17	U	0.18	U	0.17	U	0.215	U	0.175	U	0.17	U	0.18	U	0.18	U	0.17	U	0.17	U
8270S	BUTYLBENZYLPHTHALATE	0.18	U	0.069	J	0.17	U	0.18	U	0.17	U	0.215	U	0.175	U	0.042	J	0.18	U	0.18	U	0.17	U	0.05	J
8270S	DI-N-OCTYLPHTHALATE	0.18	U	2.1	J	0.17	U	0.18	U	0.17	U	0.215	U	0.175	U	0.17	U	0.18	U	0.18	U	0.17	U	0.17	U
	OTHER BASE NEUTRALS																								
8270S	P-PHENYLENEDIAMINE	0.9	U	0.85	U	0.9	U	0.95	U	0.9	U	1.1	U	0.9	U	0.9	U	0.95	U	0.95	U	0.9	U	0.9	U
8270S	SAFROLE	0.18	U	0.17	U	0.17	U	0.18	U	0.17	U	0.215	U	0.175	U	0.17	U	0.18	U	0.18	U	0.17	U	0.17	U
	ACID EXTRACTABLES																								
	PHENOLS																								
8270S	3&4-METHYLPHENOL	0.18	U	0.17	U	0.17	U	0.049	J	0.17	U	0.215	U	0.175	U	0.17	U	0.18	U	0.18	U	0.17	U	0.17	U
PCBs																									
8080S	PCB-1254	0.018	U	0.017	U	0.017	U	0.018	U	0.17	U	0.0215	U	0.0175	U	0.017	U	0.018	U	0.018	U	0.017	U	0.017	U
ORGANOCHLORINE PESTICIDES																									
8080S	4,4'-DDD	0.0018	U	0.0017	U	0.0017	U	0.0018	U	0.017	U	0.00215	U	0.023		0.0017	U	0.0018	U	0.0018	U	0.0017	U	0.043	
8080S	4,4'-DDE	0.0018	U	0.15		0.01	J	0.0041	J	0.34		0.00215	U	0.14	J	0.0042	J	0.014		0.0018	U	0.0017	U	0.1	
8080S	4,4'-DDT	0.0018	U	0.11		0.14		0.012	J	0.66		0.00215	U	0.18		0.012		0.037	J	0.0018	U	0.0086		0.31	
8080S	ALDRIN	0.0009	U	0.00085	U	0.0009	U	0.00095	U	0.009	U	0.0011	U	0.0009	U	0.0009	U	0.0009	U	0.00095	U	0.0009	U	0.0009	U
8080S	ALPHA-CHLORDANE	0.0009	U	0.00085	U	0.0075	J	0.00095	U	0.009	U	0.0011	U	0.0009	U	0.0009	U	0.0009	U	0.00095	U	0.0009	U	0.0056	J
8080S	BETA-BHC	0.0009	U	0.00085	U	0.0009	U	0.00095	U	0.009	U	0.0011	U	0.0009	U	0.0009	U	0.0009	U	0.00095	U	0.0009	U	0.0009	U
8080S	CHLOROBENZILATE	0.009	U	0.029		0.04		0.0095	U	0.09	U	0.011	U	0.009	U	0.043		0.079	J	0.0095	U	0.009	U	0.009	U
8080S	DELTA-BHC	0.0009	U	0.00085	U	0.0009	U	0.00095	U	0.009	U	0.0011	U	0.0009	U	0.0009	U	0.0009	U	0.00095	U	0.0009	U	0.0009	U
8080S	DIELDRIN	0.0089	J	0.0017	U	0.0045	J	0.0018	U	0.017	U	0.00215	U	0.00175	U	0.0017	U	0.0018	U	0.0018	U	0.0017	U	0.0017	U
8080S	ENDOSULFAN I	0.0009	U	0.00085	U	0.0078	J	0.00095	U	0.009	U	0.0011	U	0.0009	U	0.0009	U	0.0009	U	0.00095	U	0.0009	U	0.0009	U
8080S	ENDOSULFAN SULFATE	0.0018	U	0.0017	U	0.0017	U	0.0018	U	0.017	U	0.00215	U	0.00175	U	0.0058	J	0.0018	U	0.0018	U	0.0017	U	0.0017	U
8080S	ENDRIN	0.0018	U	0.0017	U	0.0017	U	0.0018	U	0.017	U	0.00215	U	0.00175	U	0.0017	U	0.0018	U	0.0018	U	0.0017	U	0.0017	U
8080S	ENDRIN ALDEHYDE	0.0018	U	0.0017	U	0.0017	U	0.0018	U	0.017	U	0.00215	U	0.00175	U	0.0017	U	0.0018	U	0.0018	U	0.0017	U	0.0017	U
8080S	GAMMA-BHC	0.0009	U	0.00085	U	0.0009	U	0.00095	U	0.009	U	0.0011	U	0.0009	U	0.0009	U	0.0009	U	0.00095	U	0.0009	U	0.0009	U
8080S	GAMMA-CHLORDANE	0.0009	U	0.00085	U	0.0089	J	0.00095	U	0.009	U	0.0011	U	0.0009	U	0.0009	U	0.0009	U	0.00095	U	0.0009	U	0.0009	U
8080S	HEPTACHLOR	0.0009	U	0.00085	U	0.0009	U	0.00095	U	0.009	U	0.0011	U	0.0009	U	0.0009	U	0.0009	U	0.00095	U	0.0009	U	0.0009	U
8080S	HEPTACHLOR EPOXIDE	0.0043	J	0.014	J	0.0035	J	0.00095	U	0.009	U	0.0011	U	0.0009	U	0.0009	U	0.0009	U	0.00095	U	0.0009	U	0.01	J
8080S	ISODRIN	0.0018	U	0.0017	U	0.0017	U	0.0018	U	0.017	U	0.00215	U	0.00175	U	0.0017	U	0.0018	U	0.0018	U	0.0017	U	0.0017	U
8080S	KEPONE	0.009	U	0.0085	U	0.009	U	0.0095	U	0.09	U	0.011	U	0.009	U	0.009	U	0.009	U	0.0095	U	0.009	U	0.009	U
8080S	METHOXYCHLOR	0.009	U	0.0085	U	0.009	U	0.0095	U	0.09	U	0.011	U	0.009	U	0.009	U	0.032		0.0095	U	0.009	U	0.009	U
ORGANOPHOSPHORUS PESTICIDES																									
814ZS	DISULFOTON	0.07	U	0.065	U	0.065	U	0.07	U	0.065	U	0.085	U	0.07	U	0.07	U	0.07	U	0.07	U	0.07	U	0.065	U
814ZS	ETHYL PARATHION	0.018	U	0.017	U	0.017	U	0.018	U	0.017	U	0.0215	U	0.0175	U	0.017	U	0.018	U	0.018	U	0.017	U	0.017	U
814ZS	METHYL PARATHION	0.009	U	0.0085	U	0.009	U	0.0095	U	0.009	U	0.011	U	0.009	U	0.009	U	0.009	U	0.0095	U	0.009	U	0.009	U
HERBICIDES																									
815ZS	2,4,5-T	0.009	U	0.0085	U	0.0085	U	0.0095	U	0.009	U	0.011	U	0.009	U	0.009	U	0.009	U	0.0095	U	0.009	U	0.009	U
815ZS	2,4,5-TP (SILVEX)	0.009	U	0.0085	U	0.0085	U	0.0095	U	0.009	U	0.011	U	0.009	U	0.009	U	0.009	U	0.0095	U	0.009	U	0.009	U
815ZS	2,4-D	0.009	U	0.0085	U	0.0085	U	0.0095	U	0.009	U	0.011	U	0.009	U	0.009	U	0.009	U	0.0095	U	0.009	U	0.009	U
815ZS	DINOSEB	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
CHLORINATED DIOXINS AND FURANS																									
SOWZS	1,2,3,4,6,7,8-HPCDD	0.000055	U	0.0000265	U	0.00006	U	0.0000295	U	0.00005	U	0.000023	U	0.00005	U	0.00005	U	0.0000355	U	0.000044	U	0.0000345	U	0.000028	U
SOWZS	1,2,3,4,6,7,8-HPCDF	0.000046	U	0.000032	U	0.000095	U	0.0000335	U	0.000055	U	0.000033	U	0.000023	U	0.000055	U	0.000037	U	0.0000405	U	0.0000365	U	0.0000415	U
SOWZS	HPCDD	0.000055	U	0.0000265	U	0.00006	U	0.0000295	U	0.00005	U	0.000023	U	0.00005	U	0.00005	U	0.0000355	U	0.000044	U	0.0000345	U	0.000028	U
SOWZS	HPCDF	0.000046	U	0.000032	U	0.000095	U	0.0000335	U	0.000055	U	0.000033	U	0.000023	U	0.000055	U	0.000037	U	0.0000405	U	0.0000365	U	0.0000415	U
SOWZS	OCDD	0.0005	F	0.00013	U	0.00083	J	0.00023	J	0.00029	U	0.00021	F	0.0007	J	0.000255	U	0.000345	U	0.000355	U	0.00061	J	0.000185	U
SOWZS	OCDF	0.0001	U	0.000065	U	0.000185	U	0.00007	U	0.00009	U	0.00007	U	0.000048	U	0.000095	U	0.000055	U	0.00008	U	0.00005	U	0.00006	U
8270S	DIBENZOFURAN	0.18	U	0.064	J	0.069	J	0.88	J	0.17	U	0.215	U	0.175	U	0.062	J	0.18	U	0.18	U	0.17	U	0.17	U

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration.

TABLE 4
CRANSTON SITE
BACKGROUND
SHALLOW SOIL
ORGANIC DATA

	AREA/SUB AREA	OF/RRW	OF/RWP	OF/SBP	OF/SNH	OS/AJHS	OS/BRF	OS/BS	OS/CGH	OS/CRS	OS/EHS	OS/FF	OS/HMEH
	SAMPLE ID	SF-OF-RRW*II-1	SF-OF-RWP*II-1	SF-OF-SBP*II-1	SF-OF-SNH*II-1	SF-OS-AJHS*IB-2	SF-OS-BRF*IB-2	SF-OS-BS*IB-2	SF-OS-CGH*IB-2	SF-OS-CRS*IB-2	SF-OS-EHS*IB-2	SF-OS-FF*IB-2	SF-OS-HMEH*IB-2
	SAMPLE DATE	7/27/93	7/27/93	7/27/93	8/4/93	3/20/91	3/20/91	3/20/91	3/20/91	3/20/91	3/20/91	3/20/91	3/20/91
	DEPTH RANGE (ft)	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
VOLATILE ORGANICS													
	HALOGENATED												
8240S	CHLOROFORM	0.0026 U	0.0026 U	0.00265 U	0.00295 U	0.06 U	0.06 U	0.055 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U
8240S	METHYLENE CHLORIDE	0.0059 J	0.009	0.011	0.00295 U	1.35 U	0.55 U	0.285 U	0.5 U	0.06 U	0.85 U	0.115 U	1.55 U
8240S	TETRACHLOROETHENE	0.0026 U	0.0058	0.0065	0.00295 U	0.06 U	0.06 U	0.055 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U
	AROMATICS												
8240S	BENZENE	0.0026 U	0.0026 U	0.00265 U	0.00295 U	0.06 U	0.06 U	0.055 U	0.06 U	0.06 U	0.06 U	0.06 U	0.024 J
8240S	M&P-XYLENE	0.0026 U	0.0026 U	0.0078	0.00295 U	0.06 U	0.06 U	0.055 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U
8240S	TOLUENE	0.0026 U	0.0059	0.0078	0.00295 U	0.49 J	0.14 J	0.04 J	0.14 J	0.023 J	0.23 J	0.048 J	0.45 J
	KETONE/ALDEHYDES												
8240S	2-BUTANONE	0.013 U	0.013 U	0.013 U	0.0145 U	0.12 U	0.19 J	0.25 J	0.21 J	0.125 U	0.24 J	0.13 J	0.2 J
8240S	ACETONE	0.013 U	0.013 U	0.013 U	0.0145 U	0.12 U	0.12 U	0.11 U	0.125 U	0.125 U	0.12 U	0.12 U	0.115 U
DIRECT INJECTION VOA													
824DS	1,4-DIOXANE	NA	NA	NA	NA	6 U	6 U	5.5 U	7 J	6 U	6 U	6 U	6 U
SEMI-VOLATILE ORGANICS													
	BASE NEUTRALS												
	PAHs												
8270S	2-METHYLNAPHTHALENE	0.17 U	0.17 U	0.175 U	0.043 J	0.205 U	0.019 J	0.18 U	0.21 U	0.205 U	0.2 U	0.2 U	0.021 J
8270S	ACENAPHTHENE	0.17 U	0.17 U	0.175 U	0.25 J	0.205 U	0.032 J	0.18 U	0.21 U	0.205 U	0.2 U	0.2 U	0.19 U
8270S	ACENAPHTHYLENE	0.17 U	0.17 U	0.175 U	0.049 J	0.205 U	0.195 U	0.18 U	0.017 J	0.205 U	0.2 U	0.2 U	0.04 J
8270S	ANTHRACENE	0.041 J	0.17 U	0.175 U	0.43	0.205 U	0.073 J	0.18 U	0.047 J	0.205 U	0.2 U	0.2 U	0.036 J
8270S	BENZO(A)ANTHRACENE	0.38	0.12 U	0.12 U	0.22	0.061 J	0.44	0.18 U	0.31 J	0.205 U	0.072 J	0.25 J	0.48
8270S	BENZO(A)PYRENE	0.3	0.12 U	0.12 U	2.3	0.082 J	0.48	0.18 U	0.35 J	0.205 U	0.06 J	0.27 J	0.56
8270S	BENZO(B)FLUORANTHENE	0.48	0.12 U	0.12 U	3.3	0.12 J	0.68	0.18 U	0.48	0.205 U	0.086 J	0.43	1
8270S	BENZO(G,H,I)PERYLENE	0.14 J	0.17 U	0.175 U	1.1	0.072 J	0.4	0.18 U	0.3 J	0.205 U	0.051 J	0.2 U	0.58
8270S	BENZO(K)FLUORANTHENE	0.19 J	0.12 U	0.12 U	1.2	0.16 J	0.87	0.18 U	0.62	0.205 U	0.11 J	0.52	1.3
8270S	CHRYSENE	0.36	0.17 U	0.175 U	2.4	0.1 J	0.61	0.18 U	0.4 J	0.17 J	0.081 J	0.38 J	0.72
8270S	DIBENZ(A,H)ANTHRACENE	0.061 J	0.105 U	0.105 U	0.35	0.205 U	0.059 J	0.18 U	0.093 J	0.205 U	0.2 U	0.2 U	0.18 J
8270S	FLUORANTHENE	0.64	0.17 U	0.175 U	4.8	0.14 J	1	0.15 J	0.71	0.25 J	0.12 J	0.47	0.79
8270S	FLUORENE	0.17 U	0.17 U	0.175 U	0.27 J	0.205 U	0.057 J	0.18 U	0.21 U	0.205 U	0.2 U	0.2 U	0.19 U
8270S	INDENO(1,2,3-CD)PYRENE	0.2 J	0.105 U	0.105 U	1.3	0.06 J	0.34 J	0.18 U	0.26 J	0.205 U	0.051 J	0.2 U	0.54
8270S	NAPHTHALENE	0.17 U	0.17 U	0.175 U	0.053 J	0.205 U	0.027 J	0.18 U	0.024 J	0.205 U	0.2 U	0.023 J	0.042 J
8270S	PHENANTHRENE	0.21 J	0.17 U	0.175 U	2.6	0.075 J	0.74	0.11 J	0.37 J	0.13 J	0.06 J	0.26 J	0.35 J
8270S	PYRENE	0.6	0.17 U	0.175 U	4.3	0.15 J	1	0.21 J	0.75	0.27 J	0.13 J	0.55	0.87
	PHTHALATES												
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	0.17 U	0.17 U	0.175 U	0.195 U	0.205 U	0.195 U	0.18 U	0.21 U	0.205 U	0.2 U	0.2 U	0.19 U
8270S	BUTYLBENZYLPHTHALATE	0.17 U	0.17 U	0.175 U	0.049 J	0.205 U	0.195 U	0.18 U	0.21 U	0.205 U	0.2 U	0.2 U	0.19 U
8270S	DI-N-OCTYLPHTHALATE	0.17 U	0.17 U	0.175 U	0.195 U	0.205 U	0.195 U	0.18 U	0.21 U	0.205 U	0.2 U	0.2 U	0.19 U
	OTHER BASE NEUTRALS												
8270S	P-PHENYLENEDIAMINE	0.9 U	0.9 U	0.9 U	1 U	1 U	0.95 U	0.9 U	1.05 U	1.05 U	1 U	1 U	0.95 U
8270S	SAFROLE	0.17 U	0.17 U	0.175 U	0.195 U	0.205 U	0.195 U	0.18 U	0.21 U	0.205 U	0.2 U	0.2 U	0.19 U
	ACID EXTRACTABLES												
	PHENOLS												
8270S	3&4-METHYLPHENOL	0.17 U	0.17 U	0.175 U	0.195 U	NA	NA	NA	NA	NA	NA	NA	NA
PCBs													
8080S	PCB-1254	0.017 U	0.017 U	0.0175 U	0.017 U	0.00405 U	0.00395 U	0.00365 U	0.16	0.00415 U	0.00405 U	0.004 U	0.195 U
ORGANOCHLORINE PESTICIDES													
8080S	4,4'-DDD	0.0017 U	0.0017 U	0.00175 U	0.0017 U	0.0015	0.000195 U	0.00018 U	0.000205 U	0.000205 U	0.0002 U	0.0002 U	0.0095 U
8080S	4,4'-DDE	0.0017 U	0.0017 U	0.00175 U	0.024 J	0.013	0.0083	0.00018 U	0.000205 U	0.0075	0.042	0.21	0.6
8080S	4,4'-DDT	0.0017 U	0.0017 U	0.00175 U	0.046	0.014	0.0056	0.000365 U	0.00041 U	0.012	0.017	0.094 J	0.93
8080S	ALDRIN	0.0009 U	0.0009 U	0.0009 U	0.0009 U	0.0002 U	0.000195 U	0.00018 U	0.000205 U	0.000205 U	0.0002 U	0.0002 U	0.0095 U
8080S	ALPHA-CHLORDANE	0.0009 U	0.0009 U	0.0009 U	0.0009 U	0.0002 U	0.000195 U	0.00018 U	0.000205 U	0.000205 U	0.0002 U	0.0002 U	0.0095 U
8080S	BETA-BHC	0.0009 U	0.0009 U	0.0009 U	0.0009 U	0.0002 U	0.000195 U	0.00018 U	0.000205 U	0.000205 U	0.0002 U	0.0002 U	0.0095 U
8080S	CHLOROBENZILATE	0.009 U	0.009 U	0.009 U	0.034 J	NA	NA	NA	NA	NA	NA	NA	NA
8080S	DELTA-BHC	0.0009 U	0.0009 U	0.0009 U	0.0009 U	0.0002 U	0.000195 U	0.00018 U	0.000205 U	0.000205 U	0.0002 U	0.0002 U	0.0095 U
8080S	DIELDRIN	0.0017 U	0.0017 U	0.00175 U	0.0017 U	0.0002 U	0.0026	0.00069	0.000205 U	0.000205 U	0.0015	0.0002 U	0.0095 U
8080S	ENDOSULFAN I	0.0009 U	0.0009 U	0.0009 U	0.0009 U	0.0002 U	0.000195 U	0.00018 U	0.000205 U	0.000205 U	0.0002 U	0.0028 J	0.0095 U
8080S	ENDOSULFAN SULFATE	0.0017 U	0.0017 U	0.00175 U	0.0017 U	0.001 U	0.001 U	0.0009 U	0.001 U	0.00105 U	0.001 U	0.001 U	0.0485 U
8080S	ENDRIN	0.0017 U	0.0017 U	0.00175 U	0.0017 U	0.00022 J	0.000195 U	0.00018 U	0.000205 U	0.000205 U	0.0002 U	0.0002 U	0.0095 U
8080S	ENDRIN ALDEHYDE	0.0017 U	0.0017 U	0.00175 U	0.0017 U	0.000405 U	0.00097	0.000365 U	0.00041 U	0.00096	0.000405 U	0.0039 J	0.0195 U
8080S	GAMMA-BHC	0.0009 U	0.0009 U	0.0009 U	0.0009 U	0.0002 U	0.000195 U	0.00055	0.000205 U	0.000205 U	0.0002 U	0.0002 U	0.0095 U
8080S	GAMMA-CHLORDANE	0.0009 U	0.0009 U	0.0009 U	0.0009 U	0.0002 U	0.000195 U	0.00018 U	0.000205 U	0.000205 U	0.0002 U	0.0002 U	0.0095 U
8080S	HEPTACHLOR	0.0009 U	0.0009 U	0.0009 U	0.0009 U	0.0002 U	0.000195 U	0.00018 U	0.000205 U	0.000205 U	0.0002 U	0.0002 U	0.0095 U
8080S	HEPTACHLOR EPOXIDE	0.0009 U	0.0009 U	0.0009 U	0.0009 U	0.0002 U	0.000195 U	0.00018 U	0.000205 U	0.000205 U	0.0002 U	0.0002 U	0.0095 U
8080S	ISODRIN	0.0017 U	0.0017 U	0.00175 U	0.0017 U	0.0002 U	0.000195 U	0.00018 U	0.000205 U	0.000205 U	0.00086	0.0002 U	0.0095 U
8080S	KEPONE	0.009 U	0.009 U	0.009 U	0.009 U	0.0002 U	0.000195 U	0.00018 U	0.06	0.000205 U	0.0002 U	0.0002 U	0.0095 U
8080S	METHOXYCHLOR	0.009 U	0.009 U	0.009 U	0.009 U	0.001 U	0.001 U	0.0009 U	0.001 U	0.00105 U	0.001 U	0.001 U	0.0485 U
ORGANOPHOSPHORUS PESTICIDES													
814ZS	DISULFOTON	0.07 U	0.07 U	0.07 U	0.075 U	0.02 U	0.0195 U	0.018 U	0.021 U	0.021 U	0.02 U	0.02 U	0.0195 U
814ZS	ETHYL PARATHION	0.017 U	0.017 U	0.0175 U	0.0195 U	0.015 U	0.015 U	0.0135 U	0.0155 U	0.0155 U	0.015 U	0.015 U	0.0145 U
814ZS	METHYL PARATHION	0.009 U	0.009 U	0.009 U	0.01 U	0.00305 U	0.00295 U	0.0027 U	0.00315 U	0.0031 U	0.00305 U	0.003 U	0.0029 U
HERBICIDES													
815ZS	2,4,5-T	0.009 U	0.009 U	0.009 U	0.01 U	0.00405 U	0.0039 U	0.0036 U	0.0042 U	0.00415 U	0.004 U	0.0039 U	0.0039 U
815ZS	2,4,5-TP (SILVEX)	0.009 U	0.009 U	0.009 U	0.01 U	0.00345 U	0.00335 U	0.00305 U	0.00355 U	0.00355 U	0.0034 U	0.00335 U	0.0033 U
815ZS	2,4-D	0.009 U	0.009 U	0.009 U	0.01 U	0.0245 U	0.0235 U	0.0215 U	0.025 U	0.025 U	0.024 U	0.0235 U	0.0235 U
815ZS	DINOSEB	NA	NA	NA	NA	0.00305 U	0.00295 U	0.0027 U	0.00315 U	0.0031 U	0.003 U	0.00295 U	0.0029 U
CHLORINATED DIOXINS AND FURANS													
SOWZS	1,2,3,4,6,7,8-HPCDD	0.0000245 U	0.000115 U	0.000066 F	0.000055 U	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	1,2,3,4,6,7,8-HPCDF	0.0000305 U	0.00009 U	0.0000265 U	0.0000475 U	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	HPCDD	0.0000245 U	0.000115 U	0.00017 F	0.000055 U	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	HPCDF	0.0000305 U	0.00009 U	0.0000265 U	0.0000475 U	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	OCDD	0.000165 U	0.00026 U	0.0012 J	0.00032 U	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	OCDF	0.000055 U	0.000165 U	0.000055 U	0.00008 U	NA	NA	NA	NA	NA	NA	NA	NA
8270S	DIBENZOFURAN	0.17 U	0.17 U	0.175 U	0.16 J	0.205 U	0.03 J	0.18 U	0.21 U	0.205 U	0.2 U	0.2 U	0.014 J

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration.

TABLE 4-
CRANSTON SITE
BACKGROUND
SHALLOW SOIL
ORGANIC DATA

AREA/SUB AREA		OS/NAS	OS/PAEH	OS/PVJHS	OS/RWP	OS/SNH	OS/SP	SUMMARY				
SAMPLE ID		SF-OS-NAS*IB-2	SF-OS-PAEH*IB-2	SF-OS-PVJHS*IB-2	SF-OS-RWP*IB-2	SF-OS-SNH*IB-2	SF-OS-SP*IB-2					
SAMPLE DATE		3/20/91	3/20/91	3/20/91	3/20/91	3/20/91	3/20/91					
DEPTH RANGE (ft)		.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q					
VOLATILE ORGANICS												
	HALOGENATED											
8240S	CHLOROFORM	0.06 U	0.055 U	0.055 U	0.055 U	0.055 U	0.055 U	1	0.032	0.0307	0.032	0.032
8240S	METHYLENE CHLORIDE	0.315 U	0.115 U	0.4 U	0.08 U	0.2 U	0.225 U	11	0.0357	0.238	0.12	0.0059
8240S	TETRACHLOROETHENE	0.06 U	0.055 U	0.055 U	0.055 U	0.055 U	0.055 U	4	0.00775	0.0319	0.011	0.0058
	AROMATICS											
8240S	BENZENE	0.06 U	0.055 U	0.055 U	0.055 U	0.055 U	0.055 U	2	0.0335	0.0301	0.043	0.024
8240S	M&P-XYLENE	0.06 U	0.055 U	0.055 U	0.055 U	0.055 U	0.055 U	2	0.008	0.0317	0.0082	0.0078
8240S	TOLUENE	0.11 J	0.029 J	0.12 J	0.034 J	0.048 J	0.052 J	20	0.17	0.0858	1.2	0.0059
	KETONE/ALDEHYDES											
8240S	2-BUTANONE	0.1 J	0.11 U	0.14 J	0.14 J	0.24 J	0.13 J	12	0.178	0.0838	0.25	0.1
8240S	ACETONE	0.115 U	0.11 U	0.11 U	0.11 U	0.115 U	0.105 U	1	0.14	0.0692	0.14	0.14
DIRECT INJECTION VOA												
824DS	1,4-DIOXANE	6 U	5.5 U	5.5 U	5.5 U	5.5 U	5.5 U	1	7	5.91	7	7
SEMI-VOLATILE ORGANICS												
	BASE NEUTRALS											
	PAHs											
8270S	2-METHYLNAPHTHALENE	0.094 J	0.18 U	0.061 J	0.185 U	1.85 U	0.175 U	10	0.557	0.334	4.5	0.019
8270S	ACENAPHTHENE	0.26 J	0.18 U	0.21 J	0.185 U	1.85 U	0.175 U	13	0.607	0.366	5.4	0.031
8270S	ACENAPHTHYLENE	0.025 J	0.18 U	0.185 U	0.185 U	1.85 U	0.175 U	14	0.224	0.261	1.4	0.017
8270S	ANTHRACENE	0.62	0.18 U	0.38	0.185 U	0.32 J	0.175 U	23	1.35	0.815	20	0.029
8270S	BENZO(A)ANTHRACENE	1.4	0.032 J	0.89	0.185 U	1.8 J	0.175 U	26	2.18	1.39	28	0.032
8270S	BENZO(A)PYRENE	1.4	0.035 J	0.73	0.185 U	2 J	0.175 U	30	1.68	1.23	22	0.035
8270S	BENZO(B)FLUORANTHENE	2.1	0.058 J	0.6	0.185 U	3.2 J	0.175 U	33	2.34	1.84	36	0.026
8270S	BENZO(G,H,I)PERYLENE	1	0.035 J	0.58	0.185 U	1.8 J	0.175 U	26	1.15	0.776	12	0.035
8270S	BENZO(K)FLUORANTHENE	2.7	0.074 J	0.77	0.185 U	4.1	0.175 U	29	2.51	1.75	43	0.047
8270S	CHRYSENE	1.6	0.043 J	0.91	0.185 U	2.1 J	0.175 U	33	1.91	1.52	30	0.039
8270S	DIBENZ(A,H)ANTHRACENE	0.24 J	0.18 U	0.2 J	0.185 U	1.85 U	0.175 U	15	0.488	0.333	3.7	0.059
8270S	FLUORANTHENE	2.9	0.056 J	1.7	0.021 J	3.8	0.175 U	39	2.77	2.53	57	0.021
8270S	FLUORENE	0.24 J	0.18 U	0.17 J	0.185 U	1.85 U	0.175 U	15	0.898	0.488	9.4	0.042
8270S	INDENO(1,2,3-CD)PYRENE	0.99	0.034 J	0.5	0.185 U	1.8 J	0.175 U	28	1.2	0.84	14	0.034
8270S	NAPHTHALENE	0.15 J	0.18 U	0.2 J	0.185 U	1.85 U	0.175 U	15	0.621	0.389	7.3	0.023
8270S	PHENANTHRENE	2.9	0.029 J	1.6	0.013 J	2.1 J	0.175 U	37	3.31	2.87	69	0.013
8270S	PYRENE	3.1	0.057 J	1.6	0.023 J	3.5 J	0.175 U	39	3.14	2.87	56	0.023
	PHTHALATES											
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	0.19 U	0.065 U	0.185 U	0.7 U	1.85 U	1.1 J	4	3.08	0.561	11	0.087
8270S	BUTYLBENZYLPHTHALATE	0.19 U	0.18 U	0.185 U	0.185 U	1.85 U	0.175 U	5	0.052	0.243	0.069	0.042
8270S	DI-N-OCTYLPHTHALATE	0.19 U	0.18 U	0.185 U	0.185 U	1.85 U	0.175 U	1	2.1	0.304	2.1	2.1
	OTHER BASE NEUTRALS											
8270S	P-PHENYLENEDIAMINE	0.95 U	0.9 U	0.9 U	0.95 U	9.5 U	0.9 U	1	5.9	1.43	5.9	5.9
8270S	SAFROLE	0.19 U	0.18 U	0.185 U	0.185 U	1.85 U	0.175 U	1	0.042	0.255	0.042	0.042
	ACID EXTRACTABLES											
	PHENOLS											
8270S	3&4-METHYLPHENOL	NA	NA	NA	NA	NA	NA	1	0.049	0.172	0.049	0.049
PCBs												
8080S	PCB-1254	0.0039 U	0.0036 U	0.00375 U	0.00375 U	0.0375 U	0.0035 U	1	0.16	0.0257	0.16	0.16
ORGANOCHLORINE PESTICIDES												
8080S	4,4'-DDD	0.000195 U	0.00018 U	0.000185 U	0.000185 U	0.0019 U	0.000175 U	7	0.168	0.0288	1.1	0.00078
8080S	4,4'-DDE	0.000195 U	0.0016	0.000185 U	0.0013	0.15	0.000175 U	24	0.128	0.072	0.81	0.0011
8080S	4,4'-DDT	0.00039 U	0.00036 U	0.008	0.00066 J	0.27	0.00035 U	26	0.471	0.286	9.3	0.00066
8080S	ALDRIN	0.000195 U	0.0017	0.000185 U	0.00078	0.0019 U	0.000175 U	2	0.00124	0.00118	0.0017	0.00078
8080S	ALPHA-CHLORDANE	0.000195 U	0.00051	0.000185 U	0.00032 J	0.0019 U	0.000175 U	5	0.00343	0.00145	0.0075	0.00032
8080S	BETA-BHC	0.061	0.00018 U	0.016	0.000185 U	0.0019 U	0.000175 U	3	0.112	0.00893	0.26	0.016
8080S	CHLOROBENZILATE	NA	NA	NA	NA	NA	NA	5	0.045	0.0233	0.079	0.029
8080S	DELTA-BHC	0.000195 U	0.00018 U	0.00092	0.000185 U	0.0019 U	0.000175 U	1	0.00092	0.00115	0.00092	0.00092
8080S	DIELDRIN	0.000195 U	0.00079	0.000185 U	0.000185 U	0.034	0.000175 U	9	0.0065	0.00299	0.034	0.00069
8080S	ENDOSULFAN I	0.000195 U	0.00018 U	0.000185 U	0.000185 U	0.0019 U	0.000175 U	2	0.0053	0.00135	0.0078	0.0028
8080S	ENDOSULFAN SULFATE	0.00095 U	0.0009 U	0.00095 U	0.00095 U	0.0095 U	0.00085 U	2	0.00595	0.00362	0.0061	0.0058
8080S	ENDRIN	0.000195 U	0.00018 U	0.000185 U	0.000185 U	0.0019 U	0.000175 U	2	0.000245	0.00179	0.00027	0.00022
8080S	ENDRIN ALDEHYDE	0.00039 U	0.00036 U	0.000375 U	0.00058 J	0.0084	0.00035 U	6	0.00264	0.00244	0.0084	0.00058
8080S	GAMMA-BHC	0.000195 U	0.00018 U	0.000185 U	0.000185 U	0.0019 U	0.000175 U	1	0.00055	0.00114	0.00055	0.00055
8080S	GAMMA-CHLORDANE	0.000195 U	0.00057	0.000185 U	0.000185 U	0.0019 U	0.000175 U	3	0.00482	0.00142	0.0089	0.00057
8080S	HEPTACHLOR	0.000195 U	0.00018 U	0.00055	0.000185 U	0.0019 U	0.000175 U	1	0.00055	0.00114	0.00055	0.00055
8080S	HEPTACHLOR EPOXIDE	0.000195 U	0.00018 U	0.000185 U	0.000185 U	0.0019 U	0.000175 U	4	0.00795	0.00179	0.014	0.0035
8080S	ISODRIN	0.000195 U	0.00018 U	0.000185 U	0.000185 U	0.0019 U	0.000175 U	2	0.00203	0.00186	0.0032	0.00086
8080S	KEPONE	0.079	0.00018 U	0.000185 U	0.0063	0.07	0.000175 U	6	0.0751	0.017	0.18	0.0063
8080S	METHOXYCHLOR	0.00095 U	0.0009 U	0.00095 U	0.00095 U	0.0095 U	0.00085 U	1	0.032	0.0098	0.032	0.032
ORGANOPHOSPHORUS PESTICIDES												
8142S	DISULFOTON	0.0195 U	0.018 U	0.0185 U	0.0185 U	0.019 U	0.0175 U	1	0.0024	0.0464	0.0024	0.0024
8142S	ETHYL PARATHION	0.0145 U	0.0135 U	0.014 U	0.014 U	0.014 U	0.0135 U	2	0.00375	0.0169	0.0041	0.0034
8142S	METHYL PARATHION	0.0029 U	0.00275 U	0.0028 U	0.0028 U	0.00285 U	0.00265 U	4	0.00393	0.00612	0.0046	0.0028
HERBICIDES												
8152S	2,4,5-T	0.0039 U	0.0036 U	0.00375 U	0.0022 J	0.0023 J	0.00355 U	2	0.00225	0.0071	0.0023	0.0022
8152S	2,4,5-TP (SILVEX)	0.0033 U	0.00305 U	0.0032 U	0.00315 U	0.0018 J	0.003 U	1	0.0018	0.00674	0.0018	0.0018
8152S	2,4-D	0.0235 U	0.0037 J	0.0225 U	0.0225 U	0.0225 U	0.0215 U	1	0.0037	0.0201	0.0037	0.0037
8152S	DINOSEB	0.0029 U	0.0027 U	0.0028 U	0.0028 U	0.00285 U	0.00265 U	1	0.0027	0.00388	0.0027	0.0027
CHLORINATED DIOXINS AND FURANS												
SOWZS	1,2,3,4,6,7,8-HPCDD	NA	NA	NA	NA	NA	NA	1	0.000066	0.000044	0.000066	0.000066
SOWZS	1,2,3,4,6,7,8-HPCDF	NA	NA	NA	NA	NA	NA	1	0.00011	0.0000443	0.00011	0.00011
SOWZS	HPCDD	NA	NA	NA	NA	NA	NA	1	0.00017	0.0000489	0.00017	0.00017
SOWZS	HPCDF	NA	NA	NA	NA	NA	NA	1	0.00015	0.0000462	0.00015	0.00015
SOWZS	OCDD	NA	NA	NA	NA	NA	NA	10	0.000612	0.000412	0.0012	0.00021
SOWZS	OCDF	NA	NA	NA	NA	NA	NA	1	0.00019	0.0000801	0.00019	0.00019
8270S	DIBENZOFURAN	0.26 J	0.18 U	0.14 J	0.185 U	1.85 U	0.175 U	13	0.999	0.484	9.7	0.014

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration.

TABLE 4-19
CRANSTON SITE
BACKGROUND/OFF-SITE
DEEP SOIL
ORGANIC DATA

	AREA/SUB AREA	BG/BGB7		BG/BGD2		BG/BGC3		BG/BGA5		SUMMARY				
	SAMPLE ID	B-BGB7*II-1		B-BGD2*II-1		B-BGC3*II-1		B-BGA5*II-1						
	SAMPLE DATE	7/28/93		7/21/93		7/21/93		7/27/93		Frequency		Average		
	DEPTH RANGE (FT)	12 to 14		2 to 4		4 to 6		8 to 10		of	Average	Reported	Maximum	Minimum
		Result	Q	Result	Q	Result	Q	Result	Q	Detection	Detected	(with 1/2 detection limit)	Detected	Detected
VOLATILE ORGANICS														
	HALOGENATED													
8240S	CHLOROFORM	0.003	U	0.00265	U	0.0031	U	0.0069		1	0.0069	0.00391	0.0069	0.0069
8240S	METHYLENE CHLORIDE	0.014		0.00265	U	0.011		0.00265	U	2	0.0125	0.00758	0.014	0.011
SEMI-VOLATILE ORGANICS														
	BASE NEUTRALS													
	PAHs													
8270S	7,12-DIMETHYLBENZ(A)ANTHRACENE	0.12	U	0.16	J	0.125	U	0.105	U	1	0.16	0.128	0.16	0.16
8270S	BENZO(A)ANTHRACENE	0.14	U	0.12	U	0.14	U	0.088	J	1	0.088	0.122	0.088	0.088
8270S	BENZO(A)PYRENE	0.14	U	0.12	U	0.14	U	0.086	J	1	0.086	0.122	0.086	0.086
8270S	BENZO(B)FLUORANTHENE	0.14	U	0.12	U	0.14	U	0.12	J	1	0.12	0.13	0.12	0.12
8270S	BENZO(G,H,I)PERYLENE	0.2	U	0.175	U	0.205	U	0.045	J	1	0.045	0.156	0.045	0.045
8270S	BENZO(K)FLUORANTHENE	0.14	U	0.12	U	0.14	U	0.051	J	1	0.051	0.113	0.051	0.051
8270S	CHRYSENE	0.2	U	0.175	U	0.205	U	0.088	J	1	0.088	0.167	0.088	0.088
8270S	FLUORANTHENE	0.043	J	0.175	U	0.05	J	0.2	J	3	0.0977	0.117	0.2	0.043
8270S	INDENO(1,2,3-CD)PYRENE	0.12	U	0.105	U	0.125	U	0.05	J	1	0.05	0.1	0.05	0.05
8270S	PHENANTHRENE	0.2	U	0.175	U	0.205	U	0.13	J	1	0.13	0.178	0.13	0.13
8270S	PYRENE	0.2	U	0.037	J	0.085	J	0.19	J	3	0.104	0.128	0.19	0.037
8270S	7,12-DIMETHYLBENZ(A)ANTHRACENE	0.12	U	0.16	J	0.125	U	0.105	U	1	0.16	0.128	0.16	0.16
ORGANOCHLORINE PESTICIDES														
8080S	METHOXYCHLOR	0.01	U	0.034	J	0.83		0.009	U	2	0.432	0.221	0.83	0.034
CHLORINATED DIOXINS AND FURANS														
SOWZS	1,2,3,4,6,7,8-HPCDD	0.0000195	U	0.00005	U	0.0000355	U	0.000062	F	1	0.000062	0.0000418	0.000062	0.000062
SOWZS	HPCDD	0.0000195	U	0.00005	U	0.0000355	U	0.00011	F	1	0.00011	0.0000538	0.00011	0.00011
SOWZS	OCDD	0.00007	U	0.00017	U	0.000135	U	0.0013	J	1	0.0013	0.000419	0.0013	0.0013

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration.

TABLE 4-19
CRANSTON SITE
BACKGROUND/OFF-SITE
DEEP SOIL
ORGANIC DATA

	AREA/SUB AREA	BG/BGB7	BG/BGD2	BG/BGC3	BG/BGA5	SUMMARY				
	SAMPLE ID	B-BGB7*II-1	B-BGD2*II-1	B-BGC3*II-1	B-BGA5*II-1					
	SAMPLE DATE	7/28/93	7/21/93	7/21/93	7/27/93	Frequency		Average		
	DEPTH RANGE (FT)	12 to 14	2 to 4	4 to 6	8 to 10	of	Average	Reported	Maximum	Minimum
		Result Q	Result Q	Result Q	Result Q	Detection	Detected	(with 1/2 detection limit)	Detected	Detected
VOLATILE ORGANICS										
	HALOGENATED									
8240S	CHLOROFORM	0.003 U	0.00265 U	0.0031 U	0.0069	1	0.0069	0.00391	0.0069	0.0069
8240S	METHYLENE CHLORIDE	0.014	0.00265 U	0.011	0.00265 U	2	0.0125	0.00758	0.014	0.011
SEMI-VOLATILE ORGANICS										
	BASE NEUTRALS									
	PAHs									
8270S	7,12-DIMETHYLBENZ(A)ANTHRACENE	0.12 U	0.16 J	0.125 U	0.105 U	1	0.16	0.128	0.16	0.16
8270S	BENZO(A)ANTHRACENE	0.14 U	0.12 U	0.14 U	0.088 J	1	0.088	0.122	0.088	0.088
8270S	BENZO(A)PYRENE	0.14 U	0.12 U	0.14 U	0.086 J	1	0.086	0.122	0.086	0.086
8270S	BENZO(B)FLUORANTHENE	0.14 U	0.12 U	0.14 U	0.12 J	1	0.12	0.13	0.12	0.12
8270S	BENZO(G,H,I)PERYLENE	0.2 U	0.175 U	0.205 U	0.045 J	1	0.045	0.156	0.045	0.045
8270S	BENZO(K)FLUORANTHENE	0.14 U	0.12 U	0.14 U	0.051 J	1	0.051	0.113	0.051	0.051
8270S	CHRYSENE	0.2 U	0.175 U	0.205 U	0.088 J	1	0.088	0.167	0.088	0.088
8270S	FLUORANTHENE	0.043 J	0.175 U	0.05 J	0.2 J	3	0.0977	0.117	0.2	0.043
8270S	*INDENO(1,2,3-CD)PYRENE*	0.12 U	0.105 U	0.125 U	0.05 J	1	0.05	0.1	0.05	0.05
8270S	PHENANTHRENE	0.2 U	0.175 U	0.205 U	0.13 J	1	0.13	0.178	0.13	0.13
8270S	PYRENE	0.2 U	0.037 J	0.085 J	0.19 J	3	0.104	0.128	0.19	0.037
8270S	7,12-DIMETHYLBENZ(A)ANTHRACENE	0.12 U	0.16 J	0.125 U	0.105 U	1	0.16	0.128	0.16	0.16
ORGANOCHLORINE PESTICIDES										
8080S	METHOXYCHLOR	0.01 U	0.034 J	0.83	0.009 U	2	0.432	0.221	0.83	0.034
CHLORINATED DIOXINS AND FURANS										
SOWZS	1,2,3,4,6,7,8-HPCDD	0.0000195 U	0.00005 U	0.0000355 U	0.000062 F	1	0.000062	0.0000418	0.000062	0.000062
SOWZS	HPCDD	0.0000195 U	0.00005 U	0.0000355 U	0.00011 F	1	0.00011	0.0000538	0.00011	0.00011
SOWZS	OCDD	0.00007 U	0.00017 U	0.000135 U	0.0013 J	1	0.0013	0.000419	0.0013	0.0013

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration.

TABLE 4-20
CRANSTON SITE
BACKGROUND/OFF-SITE
SHALLOW SOIL
INORGANIC DATA

7/26/959:28 AM

AREA/SUB AREA		BG/BGBP	BG/BGDGA	BG/BGWBGC	BG/BGWS	BG/BP	BG/BP	BG/BP	BG/ND	BG/ND	BG/PH	BG/PH	BG/WS	BG/WS	OF/APC	OF/BRF	OF/BS	OF/CGH	OF/EHS	OF/FP	OF/HMEH	OF/NAS	OF/PAEH	OF/PIP	OF/PVJHS
SAMPLE ID		SF-BG-BP*II-1	SF-BG-DGA*II-1	SF-BG-WBGC*II-1	SF-BG-WS*II-1	B-DUP6*II-1	SF-BG-BP*IB-1	SF-BG-BP*IB-2	SF-BG-ND*IB-1	SF-BG-ND*IB-2	SF-BG-PH*IB-1	SF-BG-PH*IB-2	SF-BG-WS*IB-1	SF-BG-WS*IB-2	SF-OF-APC*II-1	SF-OF-BRF*II-1	SF-OF-BS*II-1	SF-OF-CGH*II-1	SF-OF-EHS*II-1	SF-OF-FP*II-1	SF-OF-HMEH*II-1	SF-OF-NAS*II-1	SF-OF-PAEH*II-1	SF-OF-PIP*II-1	SF-OF-PVJHS*II-1
SAMPLE DATE		8/9/93	7/27/93	7/28/93	8/9/93	8/9/93	12/3/90	3/21/91	12/3/90	3/21/91	12/3/90	3/21/91	12/3/90	3/21/91	8/4/93	7/28/93	7/28/93	7/29/93	8/4/93	7/27/93	7/29/93	8/4/93	7/28/93	8/4/93	7/28/93
DEPTH RANGE (ft)		.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
6010S	BARIUM	20.1 J	44.4 J	8.7 J	27.2 J	18.8 J	49.1	275	17.9	18.2	12.1	13	24.2	18.5	22.4 J	40 J	53.4 J	30.8 J	31.6 J	26.3	17.1 J	25.1 J	26 J	19.6 J	17.9 J
6010S	BERYLLIUM	0.98 J	0.42 J	0.16 J	0.39 J	0.91 J	0.73	0.77	0.4	0.51	0.25	0.26	0.53	0.44	0.42 J	0.2 J	0.23 J	0.055 U	0.25 J	1.2	0.05 U	0.26 J	0.42 J	0.29 J	0.43 J
6010S	CADMIUM	NA	NA	NA	NA	NA	0.52	0.78	0.23 U	0.245 U	0.19 U	0.23 U	0.22 U	0.25 U	NA	NA	NA	NA	NA	0.185 U	0.145 U	NA	NA	NA	NA	NA
6010S	CALCIUM	NA	NA	NA	NA	NA	1200 J	1440 J	715 J	817 J	636 J	560 J	1240 J	803 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6010S	CHROMIUM	8.9	17.1	4.8	8	8.3	11.8	20	7.3	8	7.4	6.2	13	11	6.4	5.2	5.8	8.4	9.4	12.8	7.3	8.7	13.4	5.9	6.3
6010S	COBALT	3 J	2.3 J	2.1 J	3.3 J	2.9 J	5.2	7	1.9	2.2	2.7	1.8	5	5.1	3.3 J	3.3 J	1.9 J	2.8 J	2.8 J	3 J	1.7 J	2.5 J	2.6 J	3.4 J	4
6010S	COPPER	7.1	32.4	3.7	5.5	6.4	14.3	22.9	5.6	10.1	3.8	5.2	5.7	8.8	11.4	13.1	18.7	20.5	9.5 J	9.2	7.6	11 J	27.5	2.4 J	10
6010S	IRON	NA	NA	NA	NA	NA	13800	28300 J	8590	8230 J	8620	7240	14100	13300 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6010S	MAGNESIUM	NA	NA	NA	NA	NA	1520 J	2450	703 J	713	1390 J	683	1770 J	1910	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6010S	MANGANESE	NA	NA	NA	NA	NA	379 J	476 J	137 J	140 J	106 J	53.2 J	152 J	177 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6010S	NICKEL	3.7 J	4.6	3.2 J	8.3	3.1 J	5 U	13.3	1.45 U	6.2	3.8 U	4.6	3.65 U	9.5	5.7	5.5	5.4	4.9	6.4	3.9 J	3.4 J	4.9	5.5	4.4	6.1
6010S	POTASSIUM	NA	NA	NA	NA	NA	561 J	786 J	364 J	349 J	457 J	404 J	589 J	524 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6010S	SILVER	0.17 U	0.31 J	0.16 U	0.135 U	0.35 J	0.43 U	0.43 U	0.465 U	0.49 U	0.385 U	0.465 U	0.44 U	0.5 U	0.15 U	0.135 U	0.145 U	0.42 J	0.135 U	0.185 U	0.145 U	0.14 U	0.5 J	0.14 U	0.115 U
6010S	SODIUM	NA	NA	NA	NA	NA	43 U	230	46.5 U	211	38.5 U	197	44 U	182	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6010S	TIN	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	50 U	2.3	NA	NA	NA	NA	NA
6010S	VANADIUM	12.5	16.9	8.5 J	12.3	11.8	19.3	27.3 J	12.7	12.8 J	11.3	16.1 J	23.7	20.5 J	8.7 J	7.2 J	17.8 J	15.4 J	12.6	12.9	9.2 J	11.7	9.3 J	10.6	6.7 J
6010S	ZINC	39.4	34.8	13.3	32.3	37.7	79	219	22.7	20.9	17.4	26.8	25.8	25.9	39.9	62.4	222	51.3	53.3 J	29.2	23.1	78.3 J	76.9	17.4 J	27.7
7060S	ARSENIC	3 J	2.7	0.16 U	3.3 J	4.3 J	8.4 J	12.8 J	36.9 J	17.1 J	5.2 J	8.6 J	18.4 J	13.6 J	1.4 J	0.14 U	0.145 U	5.2 J	5.2 J	7.3 J	2.3 J	3 J	0.135 U	2.8 J	0.14 U
7421S	LEAD	37 J	251 J	12.4	24.3 J	27 J	90 J	471	166 J	43.4	11.8 J	23.3	24 J	22.1	30.8	58.3	230	122 J	97 J	25.5 J	35.8 J	153 J	59	11.8 J	13.4
7472S	MERCURY	0.05 U	0.16	0.05 U	0.05 U	0.05 U	0.28	0.81	0.03 U	0.06	0.025 U	0.0265 U	0.025 U	0.0265 U	0.04 U	0.04 U	0.045 U	0.16	0.15	0.06 U	0.045 U	0.02	0.26	0.01 U	0.035 U
7740S	SELENIUM	0.18 U	1.1 J	0.35 U	0.105 U	0.295 U	0.23 U	0.67	0.225 U	0.49	0.205 U	0.26 U	0.225 U	0.16 U	0.29 U	0.3 U	0.315 U	0.27 U	0.1 U	0.135 U	0.095 U	0.11 U	R	0.105 U	0.305 U
7841S	THALLIUM	0.17 J	0.045 U	0.04 U	0.1 J	0.06 U	0.23 U	0.265 U	0.225 U	0.245 U	0.205 U	0.26 U	0.225 U	0.16 U	0.035 U	0.035 U	0.035 U	0.055 U	0.495 U	0.065 U	0.2 J	0.05 U	0.035 U	0.05 U	0.035 U
9010S	CYANIDE	1 U	1.15 U	1 U	0.85 U	0.95 U	R	3	R	0.245 U	R	0.24 U	R	0.225 U	1.6 U	1.35 U	1.4 U	1.1 U	1 U	1.5 U	1.35 U	1.5 U	1.5 U	1.5 U	1 U
SNZZS	TIN	NA	NA	NA	NA	NA	97.2	102	4.65 U	4.9 U	3.85 U	4.65 U	4.4 U	5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Results in mg/kg (ppm).
Undetected results listed at half detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.

a:\87a4660\tech\background\OFBJK2HR.XLS

TABLE 4-20
CRANSTON SITE
BACKGROUND/OFF-SITE
SHALLOW SOIL
INORGANIC DATA

AREA/SUB AREA		OF/RCR	OF/RRW	OF/RWP	OF/SBP	OF/SNH	OS/AJHS	OS/BRF	OS/BS	OS/CGH	OS/CRS	OS/EHS	OS/FP	OS/HMEH	OS/NAS	OS/PAEH	OS/PVJHS	OS/RWP	OS/SNH	OS/SP	SUMMARY				
SAMPLE ID		SF-OF-RCR*II-1	SF-OF-RRW*II-1	SF-OF-RWP*II-1	SF-OF-SBP*II-1	SF-OF-SNH*II-1	SF-OS-AJHS*IB-2	SF-OS-BRF*IB-2	SF-OS-BS*IB-2	SF-OS-CGH*IB-2	SF-OS-CRS*IB-2	SF-OS-EHS*IB-2	SF-OS-FP*IB-2	SF-OS-HMEH*IB-2	SF-OS-NAS*IB-2	SF-OS-PAEH*IB-2	SF-OS-PVJHS*IB-2	SF-OS-RWP*IB-2	SF-OS-SNH*IB-2	SF-OS-SP*IB-2					
SAMPLE DATE		7/28/93	7/27/93	7/27/93	7/27/93	8/4/93	3/20/91	3/20/91	3/20/91	3/20/91	3/20/91	3/20/91	3/20/91	3/20/91	3/20/91	3/20/91	3/20/91	3/20/91	3/20/91	3/20/91					
DEPTH RANGE (ft)		.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q					
6010S	BARIUM	14.2 J	6.8 J	9.2 J	12.8 J	86.6 J	22.9	28.6	19.3	26.6	22.8	24.7	25.1	32.6	62.1	15.1	15.6	14.5	33.4	9.7	43	31.2	31.2	275	6.8
6010S	BERYLLIUM	0.21 J	0.045 U	0.045 U	0.67 J	0.18 J	0.42	0.41	0.31	0.57	0.54	0.4	0.67	0.39	0.37	0.37	0.44	0.44	0.3	0.19	39	0.444	0.408	1.2	0.16
6010S	CADMIUM	NA	NA	NA	NA	NA	0.25 U	0.265 U	0.235 U	0.17 U	0.24 U	0.24 U	0.23 U	0.27 U	0.215 U	0.16 U	0.15 U	0.25 U	0.25 U	0.22 U	2	0.65	0.256	0.78	0.52
6010S	CALCIUM	NA	NA	NA	NA	NA	815 J	796 J	514 J	1990 J	573 J	729 J	735 J	1250 J	1650 J	596 J	652 J	515 J	1010 J	336 J	22	890	890	1990	336
6010S	CHROMIUM	10.4	2	6.4	11	7.4	14.9	12.4	4.9	11.7	12.4	6.8	13.7	9.7	9.8	6.9	9.2	30.4	10.8	5.2	43	9.71	9.71	30.4	2
6010S	COBALT	3.6 J	1.4 J	3.1 J	7	2.5 J	3.3	3.6	2.4	3.5	4.5	2.6	2.8	2.9	2.8	4.3	5.1	4.2	2.9	2.8	43	3.28	3.28	7	1.4
6010S	COPPER	9.1	26.9	6.6	16.5	21.3 J	8.2	11.9	6.7	15.4	13.1	5.9	14.6	33.5	19.2	9.2	10.2	13.5	35.4	4.2	43	12.9	12.9	35.4	2.4
6010S	IRON	NA	NA	NA	NA	NA	12900 J	10900 J	7600 J	11500 J	16800 J	8650 J	9280 J	10900	9990 J	11300 J	12600 J	13000 J	8040 J	6120 J	22	11400	11400	28300	6120
6010S	MAGNESIUM	NA	NA	NA	NA	NA	1330	1270	747	1300	1970	1030	870	1210	1100	1600	1870	1710	1250	963	22	1330	1330	2450	683
6010S	MANGANESE	NA	NA	NA	NA	NA	111 J	118 J	85.2 J	145 J	167 J	108 J	151 J	146 J	146 J	166 J	196 J	137 J	151 J	78.4 J	22	160	160	476	53.2
6010S	NICKEL	7.5	2.2 J	5.8	13.8	4.9	8.4	6.6	4.8	8.7	11.3	3.8	5.5	7	6.5	7.9	9.3	8.2	7	4.8	39	6.32	6.06	13.8	2.2
6010S	POTASSIUM	NA	NA	NA	NA	NA	452 J	484 J	140 U	472 J	382 J	494 J	305 J	449 J	372 J	268 J	461 J	330 J	462 J	366 J	21	444	431	786	268
6010S	SILVER	0.31 J	0.14 U	0.13 U	0.155 U	0.16 U	0.5 U	0.55 U	0.465 U	0.34 U	0.475 U	0.48 U	0.465 U	0.55 U	0.43 U	0.32 U	0.305 U	0.5 U	0.495 U	0.44 U	5	0.378	0.329	0.5	0.31
6010S	SODIUM	NA	NA	NA	NA	NA	194	245	194	158	195	171	176	250	176	138	126	169	203	150	18	187	161	250	126
6010S	TIN	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	2.3	26.2	2.3	2.3
6010S	VANADIUM	9.5 J	2.2 J	6.7 J	13.2 J	10.3	24.5 J	20.5 J	11.5 J	20.9	28.8 J	13 J	18.5 J	18.3	19.2	12.4 J	12.5 J	16.6 J	14.7 J	7.8 J	43	14.2	14.2	28.8	2.2
6010S	ZINC	22.9	12.7	15.4	35.4	84.2 J	50.5	28.2	65.8	63.2	35.8	28.9	37.5	60	144	22	32.7	25	71.1	16.7	43	49.5	49.5	222	12.7
7060S	ARSENIC	0.145 U	0.09 U	3.8 J	10.1 J	2.5 J	14.5 J	18.4 J	12.4 J	11.6 J	19.4 J	14.3 J	22.6 J	42.8 J	26.7 J	9.5 J	11.2 J	12.9 J	9.8 J	6.3 J	36	11.4	9.56	42.8	1.4
7421S	LEAD	7.7	4 J	8.9 J	15 J	200 J	38.1	55.6	39.6	50	41.2	33.5	80.3	278	498	14.6	18.4	26.5	142	6	43	83.7	83.7	498	4
747ZS	MERCURY	0.045 U	0.045 U	0.045 U	0.05 U	0.01 U	0.14	0.14	0.025 U	0.08	0.06	0.028 U	0.0265 U	0.58	0.08	0.025 U	0.025 U	0.1	0.025 U	0.0235 U	15	0.205	0.0944	0.81	0.02
7740S	SELENIUM	0.315 U	0.09 U	0.085 U	0.245 U	0.09 U	0.195 U	0.21 U	0.23 U	0.27 U	0.21 U	0.275 U	0.29 U	0.235 U	0.205 U	0.245 U	0.2 U	0.195 U	0.225 U	0.19 U	3	0.753	0.25	1.1	0.49
7841S	THALLIUM	0.035 U	0.045 U	0.045 U	0.05 U	0.045 U	0.195 U	0.21 U	0.23 U	0.265 U	0.21 U	0.275 U	0.29 U	0.235 U	0.205 U	0.24 U	0.2 U	0.195 U	0.23 U	0.19 U	3	0.157	0.156	0.2	0.1
9010S	CYANIDE	1 U	1.15 U	1.1 U	1.15 U	1.65 U	0.23 U	0.225 U	0.195 U	0.245 U	0.245 U	0.22 U	0.23 U	0.245 U	0.235 U	0.18 U	0.19 U	0.235 U	0.205 U	0.205 U	1	3	0.836	3	3
SNZZS	TIN	NA	NA	NA	NA	NA	5 U	5.5 U	4.65 U	3.4 U	4.75 U	4.8 U	4.65 U	12.8	4.3 U	3.2 U	3.05 U	5 U	4.95 U	4.4 U	3	70.7	13.5	102	12.8

All results in mg/kg (ppm).
undetected results listed at detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.

TABLE 4-21
CRANSTON SITE
BACKGROUND/OFF-SITE
DEEP SOIL
INORGANIC DATA

AREA/SUB AREA	BG/BGB7		BG/BGD2		BG/BGC3		BG/BGA5		SUMMARY				
SAMPLE ID	B-BGB7*II-1		B-BGD2*II-1		B-BGC3*II-1		B-BGA5*II-1						
SAMPLE DATE	7/27/93		7/21/93		7/21/93		7/27/93						
DEPTH RANGE (ft)	12 to 14		2 to 4		4 to 6		8 to 10						
	Result	Q	Result	Q	Result	Q	Result	Q	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
METALS													
6010S BARIUM	6.4	J	13.4	J	21.3	J	8.8	J	4	12.5	12.5	21.3	6.4
6010S BERYLLIUM	0.055	U	0.68		0.6		0.24	J	3	0.507	0.394	0.68	0.24
6010S CHROMIUM	4.4		6.3		3.7		3.2		4	4.4	4.4	6.3	3.2
6010S COBALT	2.1	J	4.1	J	1.7	J	1.7	J	4	2.4	2.4	4.1	1.7
6010S COPPER	7.4		5.8		4.8		4.9		4	5.73	5.73	7.4	4.8
6010S NICKEL	5.4		5.8		2.6	J	2.9	J	4	4.18	4.18	5.8	2.6
6010S VANADIUM	4.5	J	6.8		6.7		4.3	J	4	5.58	5.58	6.8	4.3
6010S ZINC	12.7		33.6	J	28.5	J	14.3		4	22.3	22.3	33.6	12.7
7060S ARSENIC	0.09	U	1.2	J	0.74	J	0.115	U	2	0.97	0.536	1.2	0.74
7421S LEAD	3.9		2.9	J	13.4	J	4.5		4	6.18	6.18	13.4	2.9
7841S THALLIUM	0.045	U	0.21	J	0.04	U	0.365	U	1	0.21	0.165	0.21	0.21

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.

TABLE 4-21
CRANSTON SITE
BACKGROUND/OFF-SITE
DEEP SOIL
INORGANIC DATA

AREA/SUB AREA	BG/BGB7		BG/BGD2		BG/BGC3		BG/BGA5		SUMMARY				
SAMPLE ID	B-BGB7*II-1		B-BGD2*II-1		B-BGC3*II-1		B-BGA5*II-1						
SAMPLE DATE	7/27/93		7/21/93		7/21/93		7/27/93		Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
DEPTH RANGE (ft)	12 to 14		2 to 4		4 to 6		8 to 10						
	Result	Q	Result	Q	Result	Q	Result	Q					
METALS													
6010S BARIUM	6.4	J	13.4	J	21.3	J	8.8	J	4	12.5	12.5	21.3	6.4
6010S BERYLLIUM	0.055	U	0.68		0.6		0.24	J	3	0.507	0.394	0.68	0.24
6010S CHROMIUM	4.4		6.3		3.7		3.2		4	4.4	4.4	6.3	3.2
6010S COBALT	2.1	J	4.1	J	1.7	J	1.7	J	4	2.4	2.4	4.1	1.7
6010S COPPER	7.4		5.8		4.8		4.9		4	5.73	5.73	7.4	4.8
6010S NICKEL	5.4		5.8		2.6	J	2.9	J	4	4.18	4.18	5.8	2.6
6010S VANADIUM	4.5	J	6.8		6.7		4.3	J	4	5.58	5.58	6.8	4.3
6010S ZINC	12.7		33.6	J	28.5	J	14.3		4	22.3	22.3	33.6	12.7
7060S ARSENIC	0.09	U	1.2	J	0.74	J	0.115	U	2	0.97	0.536	1.2	0.74
7421S LEAD	3.9		2.9	J	13.4	J	4.5		4	6.18	6.18	13.4	2.9
7841S THALLIUM	0.045	U	0.21	J	0.04	U	0.365	U	1	0.21	0.165	0.21	0.21

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.

TABLE 4 - 22
CRANSTON SITE
PRODUCTION AREA
SHALLOW SOIL
ORGANIC DATA

	AREA/SUB AREA	AOC-13/AD152	AOC-13/E162	AOC-13/F362	AOC-13/F452	AOC-13/O162	AOC-13/O262	AOC-13/O362	AOC-13/O452	AOC-13/Y262	AOC13/A25	AOC13/A40	AOC13/AA7	AOC13/AB21	AOC13/AB24
	SAMPLE ID	B-13AD152*II-2	B-13E162*II-2	B-13F362*II-2	B-13F452*II-2	B-13O162*II-2	B-13O262*II-2	B-13O362*II-2	B-13O452*II-2	B-13Y262*II-2	SF-A13-A25(S)*IB-1	SF-A13-A40(S)*IB-1	SF-A13-AA7(S)*IB-2	SS-AB21*II-1	SS-AB24*II-1
	SAMPLE DATE	5/4/94	5/4/94	5/4/94	5/4/94	5/4/94	5/4/94	5/4/94	5/4/94	5/4/94	11/15/90	11/14/90	3/15/91	4/8/92	4/8/92
	DEPTH RANGE (ft)	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
VOLATILE ORGANICS															
	HALOGENATED														
8240S	CHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.28	0.055 U	0.055 U	NA	NA
8240S	CHLOROFORM	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.065 U	0.055 U	0.055 U	NA	NA
8240S	METHYLENE CHLORIDE	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.065 U	0.055 U	0.115 U	NA	NA
8240S	TRICHLOROFLUOROMETHANE	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.125 U	0.115 U	0.11 U	NA	NA
8240S	TETRACHLOROETHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.065 U	0.055 U	0.055 U	NA	NA
	AROMATICS														
8240S	ETHYLBENZENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.065 U	0.055 U	0.055 U	NA	NA
8240S	*M&P-XYLENE*	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.051 J	0.027 J	0.025 J	NA	NA
8240S	O-XYLENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.032 J	0.014 J	0.055 U	NA	NA
8240S	*STYRENE*	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.065 U	0.055 U	0.055 U	NA	NA
8240S	TOLUENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.13	0.049 J	0.31 U	NA	NA
SEMI-VOLATILE ORGANICS															
	BASE NEUTRALS														
	PAHs														
8270S	2-METHYLNAPHTHALENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA
8270S	ACENAPHTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA
8270S	ACENAPHTHYLENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA
8270S	ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 J	0.56 J	0.5 U	NA	NA
8270S	BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.1 J	1.8 J	0.5 U	NA	NA
8270S	BENZO(A)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.2 J	1.7 J	0.5 U	NA	NA
8270S	BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.9 J	2.8 J	0.5 U	NA	NA
8270S	BENZO(G,H,I)PERYLENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	1.7 J	0.5 U	NA	NA
8270S	BENZO(K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.9 J	3.5 J	0.5 U	NA	NA
8270S	BIS(2-CHLOROETHYL)ETHER	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.2 J	2.2 J	0.5 U	NA	NA
8270S	CHRYSENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.2 J	2 J	0.5 U	NA	NA
8270S	DIBENZ(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA
8270S	FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.4 J	3.9 J	0.5 U	NA	NA
8270S	FLUORENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA
8270S	INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	1.1 J	0.5 U	NA	NA
8270S	NAPHTHALENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	0.29 J	0.5 U	NA	NA
8270S	PHENANTHRENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	5 J	1.9 J	0.5 U	NA	NA
8270S	PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6 J	2.7 J	0.5 U	NA	NA
	PHTHALATES														
8270S	BUTYLBENZYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	33	0.5 U	NA	NA
8270S	DI-N-BUTYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	0.65 J	0.5 U	NA	NA
8270S	DI-N-OCTYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA
8270S	DIMETHYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA
	HALOGENATED														
8270S	1,2-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA
8270S	1,4-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA
8270S	4-CHLOROANILINE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA
	OTHER BASE NEUTRALS														
8270S	2-NITROANILINE	NA	NA	NA	NA	NA	NA	NA	NA	NA	31.5 U	14.5 U	2.6 U	NA	NA
8270S	NITROBENZENE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA
	ACID EXTRACTABLES														
	PHENOLS														
8270S	2,4-DIMETHYLPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA
8270S	3&4-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8270S	*4-METHYLPHENOL*	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA
8270S	PHENOL	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA
	OTHER ACID EXTRACTABLES														
8270S	ACETOPHENONE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA
8270S	ANILINE	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA
8270S	BUTAZOLIDIN	NA	NA	NA	NA	NA	NA	NA	NA	NA	31.5 U	14.5 U	2.6 U	NA	NA
FINGERPRINT COMPOUNDS															
8270S	IRGASAN DP-300	NA	NA	NA	NA	NA	NA	NA	NA	NA	31.5 U	14.5 U	2.6 U	NA	NA
8270S	TINUVIN 327	NA	NA	NA	NA	NA	NA	NA	NA	NA	31.5 U	14.5 U	2.6 U	NA	NA
8270S	TINUVIN 328	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCBs															
8080S	PCB-1248	0.1 J	0.19 J	0.96 J	0.355 U	0.28	0.175 U	3.6	4500	0.185 U	0.65 U	0.55 U	0.0055 U	R	0.23
8080S	PCB-1254	0.018 U	0.09 U	1.3 J	6.1	0.55	0.4 J	0.17 U	200 U	1.2 J	29	25	0.099	25 J	0.4
8080S	PCB-1260	0.018 U	0.09 U	0.185 U	0.355 U	0.0345 U	0.175 U	0.17 U	200 U	0.185 U	1.3 U	1.15 U	0.0105 U	R	0.0185 U
ORGANOCHLORINE PESTICIDES															
8080S	4,4'-DDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.065 U	0.055 U	0.00055 U	NA	NA
8080S	4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.065 U	0.055 U	0.00055 U	NA	NA
8080S	4,4'-DDT	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.13 U	0.115 U	0.00105 U	NA	NA
8080S	ALDRIN	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.065 U	0.055 U	0.00055 U	NA	NA
8080S	ALPHA-BHC	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.065 U	0.055 U	0.00055 U	NA	NA
8080S	ALPHA-CHLORDANE	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.065 U	0.055 U	0.00055 U	NA	NA
8080S	DELTA-BHC	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.065 U	0.055 U	0.00055 U	NA	NA
8080S	ENDOSULFAN SULFATE	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.32 U	0.285 U	0.00265 U	NA	NA
8080S	ENDRIN ALDEHYDE	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.13 U	0.115 U	0.00105 U	NA	NA
8080S	GAMMA-BHC	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.065 U	0.055 U	0.00055 U	NA	NA
8080S	GAMMA-CHLORDANE	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.065 U	0.055 U	0.00055 U	NA	NA
8080S	HEPTACHLOR	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.065 U	0.055 U	0.00055 U	NA	NA
8080S	HEPTACHLOR EPOXIDE	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.065 U	0.055 U	0.00055 U	NA	NA
8080S	KEPONE	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.065 U	0.055 U	0.00055 U	NA	NA
8080S	METHOXYCHLOR	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.32 U	0.285 U	0.00265 U	NA	NA
ORGANOPHOSPHORUS PESTICIDES															
8141S	FAMPHUR	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.155 U	0.14 U	0.135 U	NA	NA
8141S	METHYL PARATHION	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0095 U	0.0085 U	0.008 U	NA	NA
8141S	SULFOTEPP	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0315 U	0.0285 U	0.027 U	NA	NA
HERBICIDES															
8151S	2,4,5-TP (SILVEX)	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.01 U	0.0095 U	0.009 U	NA	NA
8151S	DINOSEB	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.009 U	0.0085 U	0.008 U	NA	NA
CHLORINATED DIOXINS AND FURANS															
8270S	TRCDF	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.9 J	3.3 J	1.05 U	NA	NA
SOWZS	1,2,3,4,6,7,8-HPCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	HPCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	OCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	TCDF	NA	NA	NA	NA	NA	NA	NA	NA	NA	R	R	R	NA	NA
8270S	DIBENZOFURAN	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 U	2.85 U	0.5 U	NA	NA

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
P - Estimated maximum concentration.

TABLE 4 - 22
CRANSTON SITE
PRODUCTION AREA
SHALLOW SOIL
ORGANIC DATA

AREA/SUB AREA		AOC13/AE11	AOC13/AF26	AOC13/AG23	AOC13/AJ15	AOC13/B2	AOC13/B7	AOC13/C16	AOC13/C20	AOC13/C27	AOC13/C41	AOC13/D37	AOC13/E23	AOC13/E31	AOC13/E35	AOC13/E45
SAMPLE ID		SS-AE11*II-1	SS-AF26*II-1	SS-AG23*II-1	SS-AJ15*II-1	SS-B2*II-1	SS-B7*II-1	SS-C16*II-1	SS-C20*II-1	SF-A13-C27(S)*IB-2	SF-A13-C41(S)*IB-2	SS-D37*II-1	SS-E23*II-1	SS-E31*II-1	SS-E35*II-1	SF-A13-E45(S)*IB-1
SAMPLE DATE		4/8/92	4/8/92	4/8/92	4/8/92	4/7/92	4/7/92	4/8/92	4/8/92	3/14/91	3/14/91	4/7/92	4/7/92	4/7/92	4/7/92	11/14/90
DEPTH RANGE (ft)		.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
VOLATILE ORGANICS																
	HALOGENATED															
8240S	CHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA	NA	0.086 J	0.032 J	NA	NA	NA	NA	0.055 U
8240S	CHLOROFORM	NA	NA	NA	NA	NA	NA	NA	NA	0.055 U	0.055 U	NA	NA	NA	NA	0.055 U
8240S	METHYLENE CHLORIDE	NA	NA	NA	NA	NA	NA	NA	NA	0.465 U	0.195 U	NA	NA	NA	NA	0.095 U
8240S	TRICHLOROFLUOROMETHANE	NA	NA	NA	NA	NA	NA	NA	NA	0.33	0.11 U	NA	NA	NA	NA	0.11 U
8240S	TETRACHLOROETHENE	NA	NA	NA	NA	NA	NA	NA	NA	0.055 U	0.055 U	NA	NA	NA	NA	0.055 U
	AROMATICS															
8240S	ETHYLBENZENE	NA	NA	NA	NA	NA	NA	NA	NA	0.032 J	0.055 U	NA	NA	NA	NA	0.055 U
8240S	M&P-XYLENE	NA	NA	NA	NA	NA	NA	NA	NA	0.12	0.055 U	NA	NA	NA	NA	0.029 J
8240S	O-XYLENE	NA	NA	NA	NA	NA	NA	NA	NA	0.061 J	0.055 U	NA	NA	NA	NA	0.013 J
8240S	STYRENE	NA	NA	NA	NA	NA	NA	NA	NA	0.039 J	0.055 U	NA	NA	NA	NA	0.055 U
8240S	TOLUENE	NA	NA	NA	NA	NA	NA	NA	NA	0.26 J	0.023 J	NA	NA	NA	NA	0.035 J
SEMI-VOLATILE ORGANICS																
	BASE NEUTRALS															
	PAHs															
8270S	2-METHYLNAPHTHALENE	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	2.65 U
8270S	ACENAPHTHENE	NA	NA	NA	NA	NA	NA	NA	NA	0.18 J	0.55 U	NA	NA	NA	NA	2.65 U
8270S	ACENAPHTHYLENE	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	2.65 U
8270S	ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	0.28 J	0.26 J	NA	NA	NA	NA	2.65 U
8270S	BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	0.98 J	1.1	NA	NA	NA	NA	0.84 J
8270S	BENZO(A)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	0.79 J	1.1	NA	NA	NA	NA	1.1 J
8270S	BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	1.3	1.4	NA	NA	NA	NA	2.1 J
8270S	BENZO(G,H,I)PERYLENE	NA	NA	NA	NA	NA	NA	NA	NA	0.72 J	1.1	NA	NA	NA	NA	2.65 U
8270S	BENZO(K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	1.6	1.8	NA	NA	NA	NA	1.9 J
8270S	BIS(2-CHLOROETHYL)ETHER	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	2.65 U
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	2.8 J
8270S	CHRYSENE	NA	NA	NA	NA	NA	NA	NA	NA	1.1	1.1	NA	NA	NA	NA	1.4 J
8270S	DIBENZ(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.28 J	NA	NA	NA	NA	2.65 U
8270S	FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	NA	1.9	2	NA	NA	NA	NA	1.9 J
8270S	FLUORENE	NA	NA	NA	NA	NA	NA	NA	NA	0.078 J	0.55 U	NA	NA	NA	NA	2.65 U
8270S	INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	0.55 J	0.83 J	NA	NA	NA	NA	2.65 U
8270S	NAPHTHALENE	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	0.24 J
8270S	PHENANTHRENE	NA	NA	NA	NA	NA	NA	NA	NA	0.81 J	0.94 J	NA	NA	NA	NA	0.77 J
8270S	PYRENE	NA	NA	NA	NA	NA	NA	NA	NA	2.3	2.2	NA	NA	NA	NA	1.2 J
	PHTHALATES															
8270S	BUTYLBENZYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	0.57 J
8270S	DI-N-BUTYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	2.65 U
8270S	DI-N-OCTYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	2.65 U
8270S	DIMETHYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	2.65 U
	HALOGENATED															
8270S	1,2-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	2.65 U
8270S	1,4-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	2.65 U
8270S	4-CHLOROANILINE	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	2.65 U
	OTHER BASE NEUTRALS															
8270S	2-NITROANILINE	NA	NA	NA	NA	NA	NA	NA	NA	2.85 U	2.7 U	NA	NA	NA	NA	13.5 U
8270S	NITROBENZENE	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	2.65 U
	ACID EXTRACTABLES															
	PHENOLS															
8270S	2,4-DIMETHYLPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	2.65 U
8270S	3&4-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8270S	4-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	2.65 U
8270S	PHENOL	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	2.65 U
	OTHER ACID EXTRACTABLES															
8270S	ACETOPHENONE	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	2.65 U
8270S	ANILINE	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.55 U	NA	NA	NA	NA	2.65 U
8270S	BUTAZOLIDIN	NA	NA	NA	NA	NA	NA	NA	NA	2.85 U	5.2 J	NA	NA	NA	NA	13.5 U
FINGERPRINT COMPOUNDS																
8270S	IRGASAN DP-300	NA	NA	NA	NA	NA	NA	NA	NA	1.4 J	2.7 U	NA	NA	NA	NA	13.5 U
8270S	*TINUVIN 327*	NA	NA	NA	NA	NA	NA	NA	NA	2.85 U	2.7 U	NA	NA	NA	NA	13.5 U
8270S	TINUVIN 328	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCBs																
8080S	PCB-1248	0.017 U	0.37	2 J	0.072	0.35	0.051	15 J	0.12	1.15 U	0.275 U	5.5 J	1.3	6.4 J	5.2 J	0.55 U
8080S	PCB-1254	0.31	5.2	19 J	0.86	1.7	0.34	84 J	0.6	75	14	64 J	27	47 J	58 J	51
8080S	PCB-1260	0.017 U	0.085 U	R	0.0175 U	0.019 U	0.0185 U	R	0.0185 U	2.25 U	0.55 U	R	0.375 U	R	R	1.05 U
ORGANOCHLORINE PESTICIDES																
8080S	4,4'-DDD	NA	NA	NA	NA	NA	NA	NA	NA	0.115 U	0.0275 U	NA	NA	NA	NA	0.055 U
8080S	4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA	0.115 U	0.0275 U	NA	NA	NA	NA	0.055 U
8080S	4,4'-DDT	NA	NA	NA	NA	NA	NA	NA	NA	0.225 U	0.055 U	NA	NA	NA	NA	0.105 U
8080S	ALDRIN	NA	NA	NA	NA	NA	NA	NA	NA	0.115 U	0.0275 U	NA	NA	NA	NA	0.055 U
8080S	ALPHA-BHC	NA	NA	NA	NA	NA	NA	NA	NA	0.115 U	0.0275 U	NA	NA	NA	NA	0.055 U
8080S	ALPHA-CHLORDANE	NA	NA	NA	NA	NA	NA	NA	NA	0.115 U	0.0275 U	NA	NA	NA	NA	0.055 U
8080S	DELTA-BHC	NA	NA	NA	NA	NA	NA	NA	NA	0.115 U	0.0275 U	NA	NA	NA	NA	0.055 U
8080S	ENDOSULFAN SULFATE	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.14 U	NA	NA	NA	NA	0.27 U
8080S	ENDRIN ALDEHYDE	NA	NA	NA	NA	NA	NA	NA	NA	0.225 U	0.055 U	NA	NA	NA	NA	0.105 U
8080S	GAMMA-BHC	NA	NA	NA	NA	NA	NA	NA	NA	0.115 U	0.0275 U	NA	NA	NA	NA	0.055 U
8080S	GAMMA-CHLORDANE	NA	NA	NA	NA	NA	NA	NA	NA	0.115 U	0.0275 U	NA	NA	NA	NA	0.055 U
8080S	HEPTACHLOR	NA	NA	NA	NA	NA	NA	NA	NA	0.115 U	0.0275 U	NA	NA	NA	NA	0.055 U
8080S	HEPTACHLOR EPOXIDE	NA	NA	NA	NA	NA	NA	NA	NA	0.115 U	0.0275 U	NA	NA	NA	NA	0.055 U
8080S	KEPONE	NA	NA	NA	NA	NA	NA	NA	NA	0.115 U	0.0275 U	NA	NA	NA	NA	0.055 U
8080S	METHOXYCHLOR	NA	NA	NA	NA	NA	NA	NA	NA	0.55 U	0.14 U	NA	NA	NA	NA	0.27 U
ORGANOPHOSPHORUS PESTICIDES																
8140S	FAMPHUR	NA	NA	NA	NA	NA	NA	NA	NA	0.14 U	0.135 U	NA	NA	NA	NA	0.135 U
8140S	METHYL PARATHION	NA	NA	NA	NA	NA	NA	NA	NA	0.0085 U	0.008 U	NA	NA	NA	NA	0.008 U
8140S	SULFOTEPP	NA	NA	NA	NA	NA	NA	NA	NA	0.028 U	0.027 U	NA	NA	NA	NA	0.0094 J
HERBICIDES																
8150S	2,4,5-TP (SILVEX)	NA	NA	NA	NA	NA	NA	NA	NA	0.0095 U	0.0095 U	NA	NA	NA	NA	0.0095 U
8150S	DINOSEB	NA	NA	NA	NA	NA	NA	NA	NA	0.0085 U	0.008 U	NA	NA	NA	NA	0.008 U
CHLORINATED DIOXINS AND FURANS																
8270S	TRCDF	NA	NA	NA	NA	NA	NA	NA	NA	1.15 U	1.1 U	NA	NA	NA	NA	5.5 U
SOWZS	1,2,3,4,6,7,8-HPCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	HPCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	OCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	TCDF	NA	NA	NA	NA	NA	NA	NA	NA	R	R	NA	NA	NA	NA	R
8270S	DIBENZOFURAN	NA	NA	NA	NA	NA	NA	NA	NA	0.097 J	0.55 U	NA	NA	NA	NA	2.65 U

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration.

TABLE 4 - 22
CRANSTON SITE
PRODUCTION AREA
SHALLOW SOIL
ORGANIC DATA

	AREA/SUB AREA	AOC13/F26	AOC13/G38	AOC13/G47	AOC13/I43	AOC13/J11	AOC13/J21	AOC13/J30	AOC13/J35	AOC13/J40	AOC13/J40	AOC13/J45	AOC13/J45	AOC13/K14	AOC13/K26	AOC13/L1
	SAMPLE ID	SS-F26*II-1	SS-G38*II-1	SF-A13-G47(S)*IB-2	SS-I43*II-1	SS-J11*II-1	SS-J21*II-1	SF-A13-J30(S)*IB-1	SF-A13-J35(S)*IB-1	SF-A13-J40(S)*IB-1	SF-A13-J40(S)*IB-2	SS-DUP1*II-1	SS-J45*II-1	SS-K14*II-1	SS-K26*II-1	SS-L1*II-1
	SAMPLE DATE	4/7/92	4/7/92	3/14/91	4/8/92	4/8/92	4/8/92	11/14/90	11/14/90	11/14/90	3/14/91	4/8/92	4/8/92	4/8/92	4/7/92	4/8/92
	DEPTH RANGE (ft)	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
VOLATILE ORGANICS																
	HALOGENATED															
8240S	CHLOROBENZENE	NA	NA	0.05 U	NA	NA	NA	0.047 J	0.074 J	0.055 U	0.037 J	NA	NA	NA	NA	NA
8240S	CHLOROFORM	NA	NA	0.05 U	NA	NA	NA	0.055 U	0.06 U	0.055 U	0.055 U	NA	NA	NA	NA	NA
8240S	METHYLENE CHLORIDE	NA	NA	0.05 U	NA	NA	NA	0.055 U	0.06 U	0.055 U	1.3 U	NA	NA	NA	NA	NA
8240S	TRICHLOROFLUOROMETHANE	NA	NA	0.105 U	NA	NA	NA	0.11 U	0.115 U	0.11 U	0.071 J	NA	NA	NA	NA	NA
8240S	TETRACHLOROETHENE	NA	NA	0.069 J	NA	NA	NA	0.055 U	0.06 U	0.055 U	0.055 U	NA	NA	NA	NA	NA
	AROMATICS															
8240S	ETHYLBENZENE	NA	NA	0.05 U	NA	NA	NA	0.055 U	0.06 U	0.055 U	0.047 J	NA	NA	NA	NA	NA
8240S	M&P-XYLENE	NA	NA	0.0072 J	NA	NA	NA	0.054 J	0.046 J	0.055 U	0.17	NA	NA	NA	NA	NA
8240S	O-XYLENE	NA	NA	0.05 U	NA	NA	NA	0.026 J	0.023 J	0.055 U	0.11	NA	NA	NA	NA	NA
8240S	STYRENE	NA	NA	0.05 U	NA	NA	NA	0.055 U	0.06 U	0.055 U	0.055 U	NA	NA	NA	NA	NA
8240S	TOLUENE	NA	NA	0.022 J	NA	NA	NA	0.046 J	0.046 J	0.055 U	0.42 J	NA	NA	NA	NA	NA
SEMI-VOLATILE ORGANICS																
	BASE NEUTRALS															
	PAHs															
8270S	2-METHYLNAPHTHALENE	NA	NA	0.55 U	NA	NA	NA	5.5 U	2.8 U	2.65 U	0.55 U	NA	NA	NA	NA	NA
8270S	ACENAPHTHENE	NA	NA	0.55 U	NA	NA	NA	5.5 U	2.8 U	2.65 U	0.55 U	NA	NA	NA	NA	NA
8270S	ACENAPHTHYLENE	NA	NA	0.55 U	NA	NA	NA	5.5 U	2.8 U	2.65 U	0.55 U	NA	NA	NA	NA	NA
8270S	ANTHRACENE	NA	NA	0.054 J	NA	NA	NA	5.5 U	0.29 J	0.21 J	0.14 J	NA	NA	NA	NA	NA
8270S	BENZO(A)ANTHRACENE	NA	NA	0.3 J	NA	NA	NA	5.5 U	1.1 J	0.76 J	0.57 J	NA	NA	NA	NA	NA
8270S	BENZO(A)PYRENE	NA	NA	0.34 J	NA	NA	NA	5.5 U	1.1 J	0.72 J	0.59 J	NA	NA	NA	NA	NA
8270S	BENZO(B)FLUORANTHENE	NA	NA	0.52 J	NA	NA	NA	5.5 U	0.87 J	2.65 U	0.89 J	NA	NA	NA	NA	NA
8270S	BENZO(G,H,I)PERYLENE	NA	NA	0.31 J	NA	NA	NA	5.5 U	0.89 J	0.79 J	0.67 J	NA	NA	NA	NA	NA
8270S	BENZO(K)FLUORANTHENE	NA	NA	0.66 J	NA	NA	NA	5.5 U	1.1 J	2.65 U	1.1	NA	NA	NA	NA	NA
8270S	BIS(2-CHLOROETHYL)ETHER	NA	NA	0.55 U	NA	NA	NA	5.5 U	2.8 U	2.65 U	0.55 U	NA	NA	NA	NA	NA
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	0.55 U	NA	NA	NA	1.7 J	1.8 J	4.1 J	0.55 U	NA	NA	NA	NA	NA
8270S	CHRYSENE	NA	NA	0.32 J	NA	NA	NA	5.5 U	1.1 J	0.91 J	0.66 J	NA	NA	NA	NA	NA
8270S	DIBENZ(A,H)ANTHRACENE	NA	NA	0.55 U	NA	NA	NA	5.5 U	2.8 U	2.65 U	0.2 J	NA	NA	NA	NA	NA
8270S	FLUORANTHENE	NA	NA	0.46 J	NA	NA	NA	0.83 J	2.3 J	1.6 J	0.91 J	NA	NA	NA	NA	NA
8270S	FLUORENE	NA	NA	0.55 U	NA	NA	NA	5.5 U	2.8 U	2.65 U	0.051 J	NA	NA	NA	NA	NA
8270S	INDENO(1,2,3-CD)PYRENE	NA	NA	0.29 J	NA	NA	NA	5.5 U	0.68 J	2.65 U	0.46 J	NA	NA	NA	NA	NA
8270S	NAPHTHALENE	NA	NA	0.55 U	NA	NA	NA	5.5 U	0.26 J	0.24 J	0.55 U	NA	NA	NA	NA	NA
8270S	PHENANTHRENE	NA	NA	0.21 J	NA	NA	NA	5.5 U	0.8 J	0.78 J	0.52 J	NA	NA	NA	NA	NA
8270S	PYRENE	NA	NA	0.49 J	NA	NA	NA	5.5 U	1.7 J	1.1 J	1 J	NA	NA	NA	NA	NA
	PHTHALATES															
8270S	BUTYLBENZYLPHTHALATE	NA	NA	0.55 U	NA	NA	NA	5.5 U	0.84 J	0.83 J	0.55 U	NA	NA	NA	NA	NA
8270S	DI-N-BUTYLPHTHALATE	NA	NA	0.55 U	NA	NA	NA	1.3 J	0.56 J	0.4 J	0.55 U	NA	NA	NA	NA	NA
8270S	DI-N-OCTYLPHTHALATE	NA	NA	0.55 U	NA	NA	NA	5.5 U	2.8 U	2.65 U	0.55 U	NA	NA	NA	NA	NA
8270S	DIMETHYLPHTHALATE	NA	NA	0.55 U	NA	NA	NA	5.5 U	0.25 J	2.65 U	0.55 U	NA	NA	NA	NA	NA
	HALOGENATED															
8270S	1,2-DICHLOROBENZENE	NA	NA	0.55 U	NA	NA	NA	5.5 U	2.8 U	2.65 U	0.12 J	NA	NA	NA	NA	NA
8270S	1,4-DICHLOROBENZENE	NA	NA	0.24 J	NA	NA	NA	5.5 U	2.8 U	2.65 U	0.55 U	NA	NA	NA	NA	NA
8270S	4-CHLOROANILINE	NA	NA	0.55 U	NA	NA	NA	5.5 U	2.8 U	2.65 U	0.55 U	NA	NA	NA	NA	NA
	OTHER BASE NEUTRALS															
8270S	2-NITROANILINE	NA	NA	2.65 U	NA	NA	NA	27 U	14 U	13.5 U	2.85 U	NA	NA	NA	NA	NA
8270S	NITROBENZENE	NA	NA	0.55 U	NA	NA	NA	5.5 U	2.8 U	2.65 U	0.55 U	NA	NA	NA	NA	NA
	ACID EXTRACTABLES															
	PHENOLS															
8270S	2,4-DIMETHYLPHENOL	NA	NA	0.55 U	NA	NA	NA	5.5 U	2.8 U	2.65 U	0.55 U	NA	NA	NA	NA	NA
8270S	3&4-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8270S	4-METHYLPHENOL	NA	NA	0.55 U	NA	NA	NA	5.5 U	2.8 U	2.65 U	0.55 U	NA	NA	NA	NA	NA
8270S	PHENOL	NA	NA	0.55 U	NA	NA	NA	5.5 U	2.8 U	2.65 U	0.55 U	NA	NA	NA	NA	NA
	OTHER ACID EXTRACTABLES															
8270S	ACETOPHENONE	NA	NA	0.55 U	NA	NA	NA	5.5 U	2.8 U	2.65 U	0.55 U	NA	NA	NA	NA	NA
8270S	ANILINE	NA	NA	0.55 U	NA	NA	NA	5.5 U	2.8 U	2.65 U	0.55 U	NA	NA	NA	NA	NA
8270S	BUTAZOLIDIN	NA	NA	2.65 U	NA	NA	NA	27 U	14 U	13.5 U	2.85 U	NA	NA	NA	NA	NA
FINGERPRINT COMPOUNDS																
8270S	IRGASAN DP-300	NA	NA	2.65 U	NA	NA	NA	27 U	14 U	13.5 U	2.85 U	NA	NA	NA	NA	NA
8270S	TINUVIN 327	NA	NA	2.65 U	NA	NA	NA	5.2 J	14 U	13.5 U	2.85 U	NA	NA	NA	NA	NA
8270S	TINUVIN 328	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCBs																
8080S	PCB-1248	4.8 J	5.3 J	0.265 U	2 J	0.175 U	0.22 J	0.55 U	0.6 U	0.55 U	1.15 U	19 J	19 J	0.42	0.085 U	0.175 U
8080S	PCB-1254	74 J	36 J	6.5	10 J	4.5	0.5	22	37	51	77	30 J	32 J	1.4	3.8	4.3 J
8080S	PCB-1260	R	R	0.55 U	R	0.175 U	0.0175 U	1.1 U	1.15 U	1.1 U	2.25 U	R	R	0.095 U	0.085 U	0.175 U
ORGANOCHLORINE PESTICIDES																
8080S	4,4'-DDD	NA	NA	0.0265 U	NA	NA	NA	0.055 U	0.06 U	0.055 U	0.115 U	NA	NA	NA	NA	NA
8080S	4,4'-DDE	NA	NA	0.0265 U	NA	NA	NA	0.055 U	0.06 U	0.055 U	0.115 U	NA	NA	NA	NA	NA
8080S	4,4'-DDT	NA	NA	0.055 U	NA	NA	NA	0.11 U	0.115 U	0.11 U	0.225 U	NA	NA	NA	NA	NA
8080S	ALDRIN	NA	NA	0.0265 U	NA	NA	NA	0.055 U	0.06 U	0.055 U	0.115 U	NA	NA	NA	NA	NA
8080S	ALPHA-BHC	NA	NA	0.0265 U	NA	NA	NA	0.055 U	0.06 U	0.055 U	0.115 U	NA	NA	NA	NA	NA
8080S	ALPHA-CHLORDANE	NA	NA	0.0265 U	NA	NA	NA	0.055 U	0.06 U	0.055 U	0.115 U	NA	NA	NA	NA	NA
8080S	DELTA-BHC	NA	NA	0.0265 U	NA	NA	NA	0.055 U	0.06 U	0.055 U	0.115 U	NA	NA	NA	NA	NA
8080S	ENDOSULFAN SULFATE	NA	NA	0.13 U	NA	NA	NA	0.275 U	0.29 U	0.275 U	0.55 U	NA	NA	NA	NA	NA
8080S	ENDRIN ALDEHYDE	NA	NA	0.055 U	NA	NA	NA	0.11 U	0.115 U	0.11 U	0.225 U	NA	NA	NA	NA	NA
8080S	GAMMA-BHC	NA	NA	0.0265 U	NA	NA	NA	0.055 U	0.06 U	0.055 U	0.115 U	NA	NA	NA	NA	NA
8080S	GAMMA-CHLORDANE	NA	NA	0.0265 U	NA	NA	NA	0.055 U	0.06 U	0.055 U	0.115 U	NA	NA	NA	NA	NA
8080S	HEPTACHLOR	NA	NA	0.0265 U	NA	NA	NA	0.055 U	0.06 U	0.055 U	0.115 U	NA	NA	NA	NA	NA
8080S	HEPTACHLOR EPOXIDE	NA	NA	0.0265 U	NA	NA	NA	0.055 U	0.06 U	0.055 U	0.115 U	NA	NA	NA	NA	NA
8080S	KEPONE	NA	NA	0.0265 U	NA	NA	NA	0.055 U	0.06 U	0.055 U	0.115 U	NA	NA	NA	NA	NA
8080S	METHOXYCHLOR	NA	NA	0.13 U	NA	NA	NA	0.275 U	0.29 U	0.275 U	0.55 U	NA	NA	NA	NA	NA
ORGANOPHOSPHORUS PESTICIDES																
8141S	FAMPHUR	NA	NA	0.13 U	NA	NA	NA	0.135 U	0.14 U	0.016 J	0.145 U	NA	NA	NA	NA	NA
8141S	METHYL PARATHION	NA	NA	0.0075 U	NA	NA	NA	0.008 U	0.0085 U	0.008 U	0.0085 U	NA	NA	NA	NA	NA
8141S	SULPOTEPP	NA	NA	0.026 U	NA	NA	NA	0.0275 U	0.0285 U	0.0275 U	0.0285 U	NA	NA	NA	NA	NA
HERBICIDES																
8151S	2,4,5-TP (SILVEX)	NA	NA	0.0085 U	NA	NA	NA	0.009 U	0.01 U	0.0095 U	0.0095 U	NA	NA	NA	NA	NA
8151S	DINOSEB	NA	NA	0.0075 U	NA	NA	NA	0.004 J	0.0085 U	0.0024 J	0.0085 U	NA	NA	NA	NA	NA
CHLORINATED DIOXINS AND FURANS																
8270S	TRCDF	NA	NA	1.05 U	NA	NA	NA	11 U	1.3 J	5.5 U	1.15 U	NA	NA	NA	NA	NA
SOWZS	1,2,3,4,6,7,8-HPCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	HPCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	OCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	TCDF	NA	NA	R	NA	NA	NA	R	R	R	R	NA	NA	NA	NA	NA
8270S	DIBENZOFURAN	NA	NA	0.55 U	NA	NA	NA	5.5 U	2.8 U	2.65 U	0.073 J	NA	NA	NA	NA	NA

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration.

TABLE 4 - 22
CRANSTON SITE
PRODUCTION AREA
SHALLOW SOIL
ORGANIC DATA

	AREA/SUB AREA	AOC13/L16	AOC13/L32	AOC13/L37	AOC13/L48	AOC13/M22	AOC13/M42	AOC13/N13	AOC13/N13	AOC13/N29	AOC13/N35	AOC13/O10	AOC13/O10	AOC13/O17	AOC13/O25
	SAMPLE ID	SS-L16*II-1	SF-A13-L32(S)*IB-2	SF-A13-L37(S)*IB-2	SS-L48*II-1	SS-M22*II-1	SS-M42*II-1	SS-DUP2*II-1	SS-N13*II-1	SS-N29*II-1	SS-N35*II-1	SF-A13-O10(S)*IB-1	SF-A13-O10(S)*IB-2	SS-O17*II-1	SF-A13-O25(S)*IB-1
	SAMPLE DATE	4/7/92	3/15/91	3/15/91	4/6/92	4/7/92	4/6/92	4/7/92	4/7/92	4/7/92	4/7/92	11/14/90	3/14/91	4/7/92	12/6/90
	DEPTH RANGE (ft)	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
VOLATILE ORGANICS															
	HALOGENATED														
8240S	CHLOROBENZENE	NA	0.055 U	0.055 U	NA	NA	NA	NA	NA	NA	NA	0.055 U	0.05 U	NA	0.055 U
8240S	CHLOROFORM	NA	0.055 U	0.055 U	NA	NA	NA	NA	NA	NA	NA	0.055 U	0.05 U	NA	0.055 U
8240S	METHYLENE CHLORIDE	NA	0.31 U	0.165 U	NA	NA	NA	NA	NA	NA	NA	0.055 U	0.115 U	NA	0.075 U
8240S	TRICHLOROFLUOROMETHANE	NA	0.11 U	0.11 U	NA	NA	NA	NA	NA	NA	NA	0.11 U	0.1 U	NA	0.11 U
8240S	TETRACHLOROETHENE	NA	0.055 U	0.055 U	NA	NA	NA	NA	NA	NA	NA	0.055 U	0.05 U	NA	0.055 U
	AROMATICS														
8240S	ETHYLBENZENE	NA	0.055 U	0.055 U	NA	NA	NA	NA	NA	NA	NA	0.055 U	0.0063 J	NA	0.058 J
8240S	M&P-XYLENE	NA	0.026 J	0.055 U	NA	NA	NA	NA	NA	NA	NA	0.045 J	0.023 J	NA	0.27
8240S	O-XYLENE	NA	0.0093 J	0.055 U	NA	NA	NA	NA	NA	NA	NA	0.025 J	0.012 J	NA	0.054 J
8240S	STYRENE	NA	0.055 U	0.055 U	NA	NA	NA	NA	NA	NA	NA	0.055 U	0.05 U	NA	0.055 U
8240S	TOLUENE	NA	0.235 U	0.055 U	NA	NA	NA	NA	NA	NA	NA	0.055 U	0.018 J	NA	0.055 U
SEMI-VOLATILE ORGANICS															
	BASE NEUTRALS														
	PAHs														
8270S	2-METHYLNAPHTHALENE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
8270S	ACENAPHTHENE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
8270S	ACENAPHTHYLENE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
8270S	ANTHRACENE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
8270S	BENZO(A)ANTHRACENE	NA	0.34 J	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	1.6	NA	0.16 J
8270S	BENZO(A)PYRENE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	1.7	NA	0.2 J
8270S	BENZO(B)FLUORANTHENE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	4.8	NA	0.36 J
8270S	BENZO(G,H,I)PERYLENE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	2.9	NA	0.55 U
8270S	BENZO(K)FLUORANTHENE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	5.5	NA	0.45 J
8270S	BIS(2-CHLOROETHYL)ETHER	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
8270S	CHRYSENE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	2	NA	0.19 J
8270S	DIBENZ(A,H)ANTHRACENE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.68 J	NA	0.55 U
8270S	FLUORANTHENE	NA	0.48 J	0.34 J	NA	NA	NA	NA	NA	NA	NA	5.5 U	1.1	NA	0.14 J
8270S	FLUORENE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
8270S	INDENO(1,2,3-CD)PYRENE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	2.3	NA	0.55 U
8270S	NAPHTHALENE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.18 J
8270S	PHENANTHRENE	NA	0.18 J	0.2 J	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
8270S	PYRENE	NA	0.5 J	0.34 J	NA	NA	NA	NA	NA	NA	NA	5.5 U	1.3	NA	0.14 J
	PHTHALATES														
8270S	BUTYLBENZYLPHTHALATE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
8270S	DI-N-BUTYLPHTHALATE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
8270S	DI-N-OCTYLPHTHALATE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
8270S	DIMETHYLPHTHALATE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
	HALOGENATED														
8270S	1,2-DICHLOROBENZENE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
8270S	1,4-DICHLOROBENZENE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
8270S	4-CHLOROANILINE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
	OTHER BASE NEUTRALS														
8270S	2-NITROANILINE	NA	2.7 U	2.55 U	NA	NA	NA	NA	NA	NA	NA	27 U	2.6 U	NA	2.65 U
8270S	NITROBENZENE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
	ACID EXTRACTABLES														
	PHENOLS														
8270S	2,4-DIMETHYLPHENOL	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
8270S	3&4-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8270S	4-METHYLPHENOL	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
8270S	PHENOL	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
	OTHER ACID EXTRACTABLES														
8270S	ACETOPHENONE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
8270S	ANILINE	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U
8270S	BUTAZOLIDIN	NA	2.7 U	2.55 U	NA	NA	NA	NA	NA	NA	NA	27 U	2.6 U	NA	2.65 U
FINGERPRINT COMPOUNDS															
8270S	IRGASAN DP-300	NA	2.7 U	2.55 U	NA	NA	NA	NA	NA	NA	NA	27 U	2.6 U	NA	2.65 U
8270S	TINUVIN 327	NA	2.7 U	2.55 U	NA	NA	NA	NA	NA	NA	NA	27 U	2.6 U	NA	2.65 U
8270S	TINUVIN 328	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCBs															
8080S	PCB-1248	0.3	0.275 U	0.055 U	0.32	R	28 J	5.6 J	5.9 J	3.4 J	0.02 J	0.055 U	0.05 U	6.1	0.0055 U
8080S	PCB-1254	0.75	22	4.7	0.64	37 J	61 J	31 J	26 J	25 J	0.31 J	4	5.3	11	1.4 J
8080S	PCB-1260	0.09 U	0.55 U	0.105 U	0.0175 U	R	R	R	R	R	R	0.11 U	0.105 U	0.185 U	0.011 U
ORGANOCHLORINE PESTICIDES															
8080S	4,4'-DDD	NA	0.0275 U	0.0055 U	NA	NA	NA	NA	NA	NA	NA	0.0055 U	0.005 U	NA	0.00055 U
8080S	4,4'-DDE	NA	0.0275 U	0.0055 U	NA	NA	NA	NA	NA	NA	NA	0.0055 U	0.005 U	NA	0.00055 U
8080S	4,4'-DDT	NA	0.055 U	0.0105 U	NA	NA	NA	NA	NA	NA	NA	0.011 U	0.0105 U	NA	0.0011 U
8080S	ALDRIN	NA	0.0275 U	0.0055 U	NA	NA	NA	NA	NA	NA	NA	0.0055 U	0.005 U	NA	0.00055 U
8080S	ALPHA-BHC	NA	0.0275 U	0.0055 U	NA	NA	NA	NA	NA	NA	NA	0.0055 U	0.005 U	NA	0.00055 U
8080S	ALPHA-CHLORDANE	NA	0.0275 U	0.0055 U	NA	NA	NA	NA	NA	NA	NA	0.0055 U	0.005 U	NA	0.00055 U
8080S	DELTA-BHC	NA	0.0275 U	0.0055 U	NA	NA	NA	NA	NA	NA	NA	0.0055 U	0.005 U	NA	0.00055 U
8080S	ENDOSULFAN SULFATE	NA	0.14 U	0.0265 U	NA	NA	NA	NA	NA	NA	NA	0.027 U	0.026 U	NA	0.0027 U
8080S	ENDRIN ALDEHYDE	NA	0.055 U	0.0105 U	NA	NA	NA	NA	NA	NA	NA	0.011 U	0.0105 U	NA	0.0011 U
8080S	GAMMA-BHC	NA	0.0275 U	0.0055 U	NA	NA	NA	NA	NA	NA	NA	0.0055 U	0.005 U	NA	0.0033 J
8080S	GAMMA-CHLORDANE	NA	0.0275 U	0.0055 U	NA	NA	NA	NA	NA	NA	NA	0.0055 U	0.005 U	NA	0.00055 U
8080S	HEPTACHLOR	NA	0.0275 U	0.0055 U	NA	NA	NA	NA	NA	NA	NA	0.0055 U	0.005 U	NA	0.00055 U
8080S	HEPTACHLOR EPOXIDE	NA	0.0275 U	0.0055 U	NA	NA	NA	NA	NA	NA	NA	0.0055 U	0.005 U	NA	0.00055 U
8080S	KEPONE	NA	0.0275 U	0.0055 U	NA	NA	NA	NA	NA	NA	NA	0.0055 U	0.005 U	NA	0.00055 U
8080S	METHOXYCHLOR	NA	0.14 U	0.0265 U	NA	NA	NA	NA	NA	NA	NA	0.027 U	0.026 U	NA	0.0027 U
ORGANOPHOSPHORUS PESTICIDES															
8140S	FAMPHUR	NA	0.14 U	0.135 U	NA	NA	NA	NA	NA	NA	NA	0.135 U	0.13 U	NA	0.135 U
8140S	METHYL PARATHION	NA	0.0085 U	0.008 U	NA	NA	NA	NA	NA	NA	NA	0.008 U	0.008 U	NA	0.008 U
8140S	SULFOTEPP	NA	0.028 U	0.027 U	NA	NA	NA	NA	NA	NA	NA	0.0265 U	0.026 U	NA	0.027 U
HERBICIDES															
8150S	2,4,5-TP (SILVEX)	NA	0.0095 U	0.009 U	NA	NA	NA	NA	NA	NA	NA	0.009 U	0.009 U	NA	0.0095 U
8150S	DINOSEB	NA	0.0085 U	0.008 U	NA	NA	NA	NA	NA	NA	NA	0.008 U	0.008 U	NA	0.008 U
CHLORINATED DIOXINS AND FURANS															
8270S	TRCDF	NA	1.1 U	1 U	NA	NA	NA	NA	NA	NA	NA	11 U	1.05 U	NA	1.05 U
SOWZS	1,2,3,4,6,7,8-HPCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	HPCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	OCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	TCDF	NA	R	R	NA	NA	NA	NA	NA	NA	NA	R	R	NA	R
8270S	DIBENZOFURAN	NA	0.55 U	0.5 U	NA	NA	NA	NA	NA	NA	NA	5.5 U	0.5 U	NA	0.55 U

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration.

TABLE 4 - 22
CRANSTON SITE
PRODUCTION AREA
SHALLOW SOIL
ORGANIC DATA

	AREA/SUB AREA	AOC13/O44	AOC13/O44	AOC13/O7	AOC13/Q22	AOC13/Q27	AOC13/Q38	AOC13/Q42	AOC13/R12	AOC13/R31	AOC13/S15	AOC13/S34	AOC13/T10	AOC13/T10	AOC13/T20	AOC13/U17	AOC13/U28
	SAMPLE ID	SF-O44*II-1	SS-O44*II-1	SS-O7*II-1	SS-Q22*II-1	SF-A13-Q27(S)*IB-2	SS-Q38*II-1	SS-Q42*II-1	SS-R12*II-1	SS-R31*II-1	SS-S15*II-1	SS-S34*II-1	SF-A13-T10(S)*IB-1	SF-A13-T10(S)*IB-2	SS-T20*II-1	SS-U17*II-1	SS-U28*II-1
	SAMPLE DATE	8/4/93	4/6/92	4/8/92	4/7/92	3/15/91	4/8/92	4/6/92	4/8/92	4/7/92	4/8/92	4/7/92	11/14/90	3/14/91	4/8/92	4/8/92	4/8/92
	DEPTH RANGE (ft)	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
VOLATILE ORGANICS																	
	HALOGENATED																
8240S	CHLOROBENZENE	NA	NA	NA	NA	0.06 U	NA	NA	NA	NA	NA	NA	0.086 J	0.055 U	NA	NA	NA
8240S	CHLOROFORM	NA	NA	NA	NA	0.06 U	NA	NA	NA	NA	NA	NA	0.05 U	0.034 J	NA	NA	NA
8240S	METHYLENE CHLORIDE	NA	NA	NA	NA	0.8 U	NA	NA	NA	NA	NA	NA	0.05 U	0.14 U	NA	NA	NA
8240S	TRICHLOROFLUOROMETHANE	NA	NA	NA	NA	0.29	NA	NA	NA	NA	NA	NA	0.105 U	0.11 U	NA	NA	NA
8240S	TETRACHLOROETHENE	NA	NA	NA	NA	0.06 U	NA	NA	NA	NA	NA	NA	0.05 U	0.055 U	NA	NA	NA
	AROMATICS																
8240S	ETHYLBENZENE	NA	NA	NA	NA	0.06 U	NA	NA	NA	NA	NA	NA	0.05 U	0.038 J	NA	NA	NA
8240S	M&P-XYLENE	NA	NA	NA	NA	0.067 J	NA	NA	NA	NA	NA	NA	0.068 J	0.1 J	NA	NA	NA
8240S	O-XYLENE	NA	NA	NA	NA	0.032 J	NA	NA	NA	NA	NA	NA	0.022 J	0.031 J	NA	NA	NA
8240S	STYRENE	NA	NA	NA	NA	0.06 U	NA	NA	NA	NA	NA	NA	0.05 U	0.055 U	NA	NA	NA
8240S	TOLUENE	NA	NA	NA	NA	0.06 U	NA	NA	NA	NA	NA	NA	0.027 J	0.039 J	NA	NA	NA
SEMI-VOLATILE ORGANICS																	
	BASE NEUTRALS																
	PAHs																
8270S	2-METHYLNAPHTHALENE	NA	NA	NA	NA	0.38 J	NA	NA	NA	NA	NA	NA	2.55 U	0.55 U	NA	NA	NA
8270S	ACENAPHTHENE	NA	NA	NA	NA	0.14 J	NA	NA	NA	NA	NA	NA	2.55 U	0.55 U	NA	NA	NA
8270S	ACENAPHTHYLENE	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.043 J	NA	NA	NA
8270S	ANTHRACENE	NA	NA	NA	NA	0.23 J	NA	NA	NA	NA	NA	NA	0.36 J	0.16 J	NA	NA	NA
8270S	BENZO(A)ANTHRACENE	NA	NA	NA	NA	0.44 J	NA	NA	NA	NA	NA	NA	0.92 J	1.3	NA	NA	NA
8270S	BENZO(A)PYRENE	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	1.3	NA	NA	NA
8270S	BENZO(B)FLUORANTHENE	NA	NA	NA	NA	0.73 J	NA	NA	NA	NA	NA	NA	2 J	2	NA	NA	NA
8270S	BENZO(G,H,I)PERYLENE	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.99 J	NA	NA	NA
8270S	BENZO(K)FLUORANTHENE	NA	NA	NA	NA	0.88 J	NA	NA	NA	NA	NA	NA	1.8 J	2.6	NA	NA	NA
8270S	BIS(2-CHLOROETHYL)ETHER	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.68 J	NA	NA	NA
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.55 U	NA	NA	NA
8270S	CHRYSENE	NA	NA	NA	NA	0.45 J	NA	NA	NA	NA	NA	NA	1.3 J	1.5	NA	NA	NA
8270S	DIBENZ(A,H)ANTHRACENE	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.32 J	NA	NA	NA
8270S	FLUORANTHENE	NA	NA	NA	NA	0.62 J	NA	NA	NA	NA	NA	NA	2.2 J	2.1	NA	NA	NA
8270S	FLUORENE	NA	NA	NA	NA	0.11 J	NA	NA	NA	NA	NA	NA	2.55 U	0.048 J	NA	NA	NA
8270S	INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.86 J	NA	NA	NA
8270S	NAPHTHALENE	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	0.43 J	0.55 U	NA	NA	NA
8270S	PHENANTHRENE	NA	NA	NA	NA	0.62 J	NA	NA	NA	NA	NA	NA	1.4 J	0.8 J	NA	NA	NA
8270S	PYRENE	NA	NA	NA	NA	0.74 J	NA	NA	NA	NA	NA	NA	1.3 J	2.3	NA	NA	NA
	PHTHALATES																
8270S	BUTYLBENZYLPHTHALATE	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	1.2 J	0.55 U	NA	NA	NA
8270S	DI-N-BUTYLPHTHALATE	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.55 U	NA	NA	NA
8270S	DI-N-OCTYLPHTHALATE	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.55 U	NA	NA	NA
8270S	DIMETHYLPHTHALATE	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.55 U	NA	NA	NA
	HALOGENATED																
8270S	1,2-DICHLOROBENZENE	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.55 U	NA	NA	NA
8270S	1,4-DICHLOROBENZENE	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.55 U	NA	NA	NA
8270S	4-CHLOROANILINE	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.55 U	NA	NA	NA
	OTHER BASE NEUTRALS																
8270S	2-NITROANILINE	NA	NA	NA	NA	2.8 U	NA	NA	NA	NA	NA	NA	13 U	2.7 U	NA	NA	NA
8270S	NITROBENZENE	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.55 U	NA	NA	NA
	ACID EXTRACTABLES																
	PHENOLS																
8270S	2,4-DIMETHYLPHENOL	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.55 U	NA	NA	NA
8270S	3&4-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8270S	4-METHYLPHENOL	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.24 J	NA	NA	NA
8270S	PHENOL	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.63 J	NA	NA	NA
	OTHER ACID EXTRACTABLES																
8270S	ACETOPHENONE	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.55 U	NA	NA	NA
8270S	ANILINE	NA	NA	NA	NA	0.55 U	NA	NA	NA	NA	NA	NA	2.55 U	0.55 U	NA	NA	NA
8270S	BUTAZOLIDIN	NA	NA	NA	NA	2.8 U	NA	NA	NA	NA	NA	NA	13 U	2.7 U	NA	NA	NA
FINGERPRINT COMPOUNDS																	
8270S	IRGASAN DP-300	NA	NA	NA	NA	4.2 J	NA	NA	NA	NA	NA	NA	13 U	2.7 U	NA	NA	NA
8270S	TINUVIN 327	NA	NA	NA	NA	2.8 U	NA	NA	NA	NA	NA	NA	13 U	2.7 U	NA	NA	NA
8270S	TINUVIN 328	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCBs																	
8080S	PCB-1248	150	430 J	0.017 U	R	0.55 U	0.034 U	0.085	0.0175 U	0.017 U	0.0175 U	4.4 J	0.05 U	0.055 U	R	0.018 U	0.175 U
8080S	PCB-1254	7 U	R	0.46	35 J	30	0.78	0.16	0.86	0.21	1.1	35 J	2.7	1.8	58 J	0.018 U	5.6
8080S	PCB-1260	7 U	R	0.017 U	R	1.15 U	0.034 U	0.018 U	0.0175 U	0.017 U	0.0175 U	R	0.105 U	0.11 U	R	0.018 U	0.175 U
ORGANOCHLORINE PESTICIDES																	
8080S	4,4'-DDD	0.7 U	NA	NA	NA	0.055 U	NA	NA	NA	NA	NA	NA	0.005 U	0.0055 U	NA	NA	NA
8080S	4,4'-DDE	0.7 U	NA	NA	NA	0.055 U	NA	NA	NA	NA	NA	NA	0.005 U	0.0055 U	NA	NA	NA
8080S	4,4'-DDT	0.7 U	NA	NA	NA	0.115 U	NA	NA	NA	NA	NA	NA	0.0105 U	0.011 U	NA	NA	NA
8080S	ALDRIN	0.375 U	NA	NA	NA	0.055 U	NA	NA	NA	NA	NA	NA	0.005 U	0.0055 U	NA	NA	NA
8080S	ALPHA-BHC	0.375 U	NA	NA	NA	0.055 U	NA	NA	NA	NA	NA	NA	0.0099 J	0.0055 U	NA	NA	NA
8080S	ALPHA-CHLORDANE	0.375 U	NA	NA	NA	0.055 U	NA	NA	NA	NA	NA	NA	0.005 U	0.0055 U	NA	NA	NA
8080S	DELTA-BHC	0.375 U	NA	NA	NA	0.055 U	NA	NA	NA	NA	NA	NA	0.005 U	0.0055 U	NA	NA	NA
8080S	ENDOSULFAN SULFATE	0.7 U	NA	NA	NA	0.285 U	NA	NA	NA	NA	NA	NA	0.026 U	0.0275 U	NA	NA	NA
8080S	ENDRIN ALDEHYDE	0.7 U	NA	NA	NA	0.115 U	NA	NA	NA	NA	NA	NA	0.0105 U	0.011 U	NA	NA	NA
8080S	GAMMA-BHC	0.375 U	NA	NA	NA	0.055 U	NA	NA	NA	NA	NA	NA	0.005 U	0.0055 U	NA	NA	NA
8080S	GAMMA-CHLORDANE	1.7 J	NA	NA	NA	0.055 U	NA	NA	NA	NA	NA	NA	0.005 U	0.0055 U	NA	NA	NA
8080S	HEPTACHLOR	0.375 U	NA	NA	NA	0.055 U	NA	NA	NA	NA	NA	NA	0.005 U	0.0055 U	NA	NA	NA
8080S	HEPTACHLOR EPOXIDE	0.375 U	NA	NA	NA	0.055 U	NA	NA	NA	NA	NA	NA	0.005 U	0.0055 U	NA	NA	NA
8080S	KEPONE	3.75 U	NA	NA	NA	0.055 U	NA	NA	NA	NA	NA	NA	0.005 U	0.0055 U	NA	NA	NA
8080S	METHOXYCHLOR	3.75 U	NA	NA	NA	0.285 U	NA	NA	NA	NA	NA	NA	0.026 U	0.0275 U	NA	NA	NA
ORGANOPHOSPHORUS PESTICIDES																	
8141S	FAMPHUR	NA	NA	NA	NA	0.145 U	NA	NA	NA	NA	NA	NA	0.13 U	0.135 U	NA	NA	NA
8141S	METHYL PARATHION	NA	NA	NA	NA	0.0085 U	NA	NA	NA	NA	NA	NA	0.008 U	0.008 U	NA	NA	NA
8141S	SULFOTEPP	NA	NA	NA	NA	0.029 U	NA	NA	NA	NA	NA	NA	0.026 U	0.027 U	NA	NA	NA
HERBICIDES																	
8151S	2,4,5-TP (SILVEX)	NA	NA	NA	NA	0.0095 U	NA	NA	NA	NA	NA	NA	0.009 U	0.009 U	NA	NA	NA
8151S	DINOSEB	NA	NA	NA	NA	0.0085 U	NA	NA	NA	NA	NA	NA	0.008 U	0.008 U	NA	NA	NA
CHLORINATED DIOXINS AND FURANS																	
8270S	TRCDF	NA	NA	NA	NA	2.7 J	NA	NA	NA	NA	NA	NA	5 U	1.1 U	NA	NA	NA
SOWZS	1,2,3,4,6,7,8-HPCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	HPCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	OCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SOWZS	TCDF	NA	NA	NA	NA	R	NA	NA	NA	NA	NA	NA	R	R	NA	NA	NA
8270S	DIBENZOFURAN	NA	NA	NA	NA	0.13 J	NA	NA	NA	NA	NA	NA	2.55 U	0.55 U	NA	NA	NA

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration.

TABLE 4 - 22
CRANSTON SITE
PRODUCTION AREA
SHALLOW SOIL
ORGANIC DATA

	AREA/SUB AREA	AOC13/U36	AOC13/V23	AOC13/W13	AOC13/W13	AOC13/W32	AOC13/Y15	AOC13/Y21	AOC13/Y5	AOC13/Y5	AOC13/Z28	SWMU2/B2E1	SWMU2/B2F	SWMU3/B3E	SWMU3/B3F1	SWMU3/B3G	SWMU3/B3I1
	SAMPLE ID	SS-U36*II-1	SS-V23*II-1	SS-DUP3*II-1	SS-W13*II-1	SS-W32*II-1	SS-Y15*II-1	SS-Y21*II-1	SF-A13-Y5(S)*IB-1	SF-DUP-1*IB-1	SS-Z28*II-1	B-2E1*II-1	B-2F1*II-1	B-3E1*II-1	B-3F1*II-1	B-3G1*II-1	B-3I1*II-1
	SAMPLE DATE	4/6/92	4/8/92	4/8/92	4/8/92	4/7/92	4/8/92	4/8/92	11/14/90	11/14/90	4/8/92	7/9/93	7/9/93	7/12/93	7/12/93	7/12/93	7/13/93
	DEPTH RANGE (ft)	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
VOLATILE ORGANICS																	
	HALOGENATED																
8240S	CHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA	0.05 U	NA	NA	0.00255 U	NA	0.00255 U	0.00255 U	0.0026 U	0.0026 U
8240S	CHLOROFORM	NA	NA	NA	NA	NA	NA	NA	0.05 U	NA	NA	0.00255 U	NA	0.00255 U	0.00255 U	0.0026 U	0.0026 U
8240S	METHYLENE CHLORIDE	NA	NA	NA	NA	NA	NA	NA	0.05 U	NA	NA	0.00255 U	NA	0.0054	0.0056	0.0026 U	0.0026 U
8240S	TRICHLOROFLUOROMETHANE	NA	NA	NA	NA	NA	NA	NA	0.105 U	NA	NA	0.00255 U	NA	0.00255 U	0.00255 U	0.0026 U	0.0026 U
8240S	TETRACHLOROETHENE	NA	NA	NA	NA	NA	NA	NA	0.05 U	NA	NA	0.00255 U	NA	0.00255 U	0.00255 U	0.0026 U	0.0026 U
	AROMATICS																
8240S	ETHYLBENZENE	NA	NA	NA	NA	NA	NA	NA	0.05 U	NA	NA	0.00255 U	NA	0.00255 U	0.00255 U	0.0026 U	0.0026 U
8240S	M&P-XYLENE	NA	NA	NA	NA	NA	NA	NA	0.05 U	NA	NA	0.00255 U	NA	0.00255 U	0.00255 U	0.0026 U	0.0026 U
8240S	O-XYLENE	NA	NA	NA	NA	NA	NA	NA	0.05 U	NA	NA	0.00255 U	NA	0.00255 U	0.00255 U	0.0026 U	0.0026 U
8240S	STYRENE	NA	NA	NA	NA	NA	NA	NA	0.05 U	NA	NA	0.00255 U	NA	0.00255 U	0.00255 U	0.0026 U	0.0026 U
8240S	TOLUENE	NA	NA	NA	NA	NA	NA	NA	0.05 U	NA	NA	0.00255 U	NA	0.00255 U	0.00255 U	0.0026 U	0.0026 U
SEMI-VOLATILE ORGANICS																	
	BASE NEUTRALS																
	PAHs																
8270S	2-METHYLNAPHTHALENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.17 U
8270S	ACENAPHTHENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.13 J
8270S	ACENAPHTHYLENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.18 J	0.048 J
8270S	ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.034 J	0.17 U	0.17 U	0.083 J	0.38
8270S	BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.115 U	0.23 J	0.115 U	0.115 U	0.52	1.4 J
8270S	BENZO(A)PYRENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.024 J	0.26	0.115 U	0.046 J	0.88 J	1.4 J
8270S	BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.028 J	0.37	0.115 U	0.048 J	1.2 J	2 J
8270S	BENZO(G,H,I)PERYLENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.13 J	0.17 U	0.17 U	0.52 J	0.83 J
8270S	BENZO(K)FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.115 U	0.16 J	0.115 U	0.115 U	0.51 J	0.64 J
8270S	BIS(2-CHLOROETHYL)ETHER	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.17 U
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.072 J	0.13 J	0.092 J	0.12 J	0.17 J	0.4 J
8270S	CHRYSENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.27 J	0.17 U	0.17 U	0.59	1.3 J
8270S	DIBENZ(A,H)ANTHRACENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.1 U	0.105 U	0.1 U	0.1 U	0.13 J	0.2 J
8270S	FLUORANTHENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.47	0.17 U	0.051 J	0.81	2.2
8270S	FLUORENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.12 J
8270S	INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.1 U	0.14 J	0.1 U	0.1 U	0.54 J	0.85 J
8270S	NAPHTHALENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.037 J
8270S	PHENANTHRENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.18 J	0.17 U	0.17 U	0.093 J	1.5
8270S	PYRENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.47	0.17 U	0.061 J	1.3	4.5 J
	PHTHALATES																
8270S	BUTYLBENZYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.19 J
8270S	DI-N-BUTYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.17 U
8270S	DI-N-OCTYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.17 U
8270S	DIMETHYLPHTHALATE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.17 U
	HALOGENATED																
8270S	1,2-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.17 U
8270S	1,4-DICHLOROBENZENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.17 U
8270S	4-CHLOROANILINE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.335 U	0.35 U	0.335 U	0.046 J	0.34 U	0.046 J
	OTHER BASE NEUTRALS																
8270S	2-NITROANILINE	NA	NA	NA	NA	NA	NA	NA	2.55 U	NA	NA	0.85 U	0.9 U	0.3 J	0.89 J	0.9 U	0.9 U
8270S	NITROBENZENE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.17 U
	ACID EXTRACTABLES																
	PHENOLS																
8270S	2,4-DIMETHYLPHENOL	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.17 U
8270S	3&4-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.17 U	0.175 U	0.77	0.17 U	0.092 J	0.17 U
8270S	4-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	NA	NA	NA	NA	NA	NA
8270S	PHENOL	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.17 U
	OTHER ACID EXTRACTABLES																
8270S	ACETOPHENONE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.17 U
8270S	ANILINE	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.17 U
8270S	BUTAZOLIDIN	NA	NA	NA	NA	NA	NA	NA	2.55 U	NA	NA	NA	NA	NA	NA	NA	NA
FINGERPRINT COMPOUNDS																	
8270S	IRGASAN DP-300	NA	NA	NA	NA	NA	NA	NA	2.55 U	NA	NA	NA	NA	NA	NA	NA	NA
8270S	TINUVIN 327	NA	NA	NA	NA	NA	NA	NA	2.55 U	NA	NA	NA	NA	NA	NA	NA	NA
8270S	TINUVIN 328	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.6	NA	NA
PCBs																	
8080S	PCB-1248	4.1 J	0.018 U	0.0175 U	0.017 U	0.021 U	0.18 U	0.65	0.005 U	0.005 U	0.09 U	0.017 U	0.0175 U	0.17 U	0.17 U	0.017 U	0.085 U
8080S	PCB-1254	31 J	0.4	0.043 J	0.068 J	0.055	7.6	6.8	0.01 U	0.01 U	1.8	0.15 J	0.19	2.3	5.3	0.99 J	4.8 J
8080S	PCB-1260	R	0.018 U	0.0175 U	0.017 U	0.021 U	0.18 U	0.18 U	0.01 U	0.01 U	0.09 U	0.13	0.24	3.2	3	0.017 U	0.085 U
ORGANOCHLORINE PESTICIDES																	
8080S	4,4'-DDD	NA	NA	NA	NA	NA	NA	NA	0.0033 J	0.0005 U	NA	0.0017 U	0.00175 U	0.017 U	0.017 U	0.0017 U	0.0085 U
8080S	4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	0.0005 U	0.0005 U	NA	0.0017 U	0.00175 U	0.017 U	0.017 U	0.0017 U	0.0085 U
8080S	4,4'-DDT	NA	NA	NA	NA	NA	NA	NA	0.001 U	0.001 U	NA	0.0017 U	0.00175 U	0.017 U	0.017 U	0.0017 U	0.0085 U
8080S	ALDRIN	NA	NA	NA	NA	NA	NA	NA	0.0035 J	0.0005 U	NA	0.00085 U	0.0009 U	0.0085 U	0.0085 U	0.00085 U	0.0044 U
8080S	ALPHA-BHC	NA	NA	NA	NA	NA	NA	NA	0.0016 J	0.0005 U	NA	0.00085 U	0.0009 U	0.0085 U	0.0085 U	0.00085 U	0.0044 U
8080S	ALPHA-CHLORDANE	NA	NA	NA	NA	NA	NA	NA	0.0097 J	0.0005 U	NA	0.00085 U	0.0009 U	0.0085 U	0.0085 U	0.00085 U	0.0044 U
8080S	DELTA-BHC	NA	NA	NA	NA	NA	NA	NA	0.0024 J	0.0005 U	NA	0.00085 U	0.0009 U	0.0085 U	0.0085 U	0.00085 U	0.0044 U
8080S	ENDOSULFAN SULFATE	NA	NA	NA	NA	NA	NA	NA	0.00255 U	0.00255 U	NA	0.0017 U	0.00175 U	0.017 U	0.017 U	0.0017 U	0.0085 U
8080S	ENDRIN ALDEHYDE	NA	NA	NA	NA	NA	NA	NA	0.001 U	0.001 J	NA	0.0017 U	0.00175 U	0.017 U	0.017 U	0.0017 U	0.0085 U
8080S	GAMMA-BHC	NA	NA	NA	NA	NA	NA	NA	0.0033 J	0.0005 U	NA	0.00085 U	0.0009 U	0.0085 U	0.0085 U	0.00085 U	0.0044 U
8080S	GAMMA-CHLORDANE	NA	NA	NA	NA	NA	NA	NA	0.0075 J	0.0005 U	NA	0.00085 U	0.0009 U	0.0085 U	0.0085 U	0.00085 U	0.028 J
8080S	HEPTACHLOR	NA	NA	NA	NA	NA	NA	NA	0.0005 U	0.0005 U	NA	0.00085 U	0.0009 U	0.0085 U	0.0085 U	0.00085 U	0.0044 U
8080S	HEPTACHLOR EPOXIDE	NA	NA	NA	NA	NA	NA	NA	0.0005 U	0.0005 U	NA	0.00085 U	0.0009 U	0.0085 U	0.0085 U	0.00085 U	0.0044 U
8080S	KEPONE	NA	NA	NA	NA	NA	NA	NA	0.0005 U	0.015 J	NA	0.0085 U	0.009 U	0.085 U	0.085 U	0.0085 U	0.0044 U
8080S	METHOXYCHLOR	NA	NA	NA	NA	NA	NA	NA	0.00255 U	0.00255 U	NA	0.0085 U	0.47 D	0.085 U	0.29	0.12 J	0.27 J
ORGANOPHOSPHORUS PESTICIDES																	
8140S	FAMPHUR	NA	NA	NA	NA	NA	NA	NA	0.13 U	0.13 U	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.17 U
8140S	METHYL PARATHION	NA	NA	NA	NA	NA	NA	NA	0.0065 J	0.0075 U	NA	0.0085 U	0.009 U	0.0085 U	0.0085 U	0.0085 U	0.009 U
8140S	SULFOTEPP	NA	NA	NA	NA	NA	NA	NA	0.0255 U	0.0255 U	NA	0.0085 U	0.009 U	0.0085 U	0.0085 U	0.0085 U	0.009 U
HERBICIDES																	
8150S	2,4,5-TP (SILVEX)	NA	NA	NA	NA	NA	NA	NA	0.0085 U	0.0085 U	NA	0.0085 U	NA	NA	NA	NA	NA
8150S	DINOSEB	NA	NA	NA	NA	NA	NA	NA	0.0075 U	0.0075 U	NA	NA	NA	NA	NA	NA	NA
CHLORINATED DIOXINS AND FURANS																	
8270S	TRCDF	NA	NA	NA	NA	NA	NA	NA	1 U	NA	NA	0.73 J	NA	NA	0.4 J	NA	NA
SOWZS	1,2,3,4,6,7,8-HPCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0000385 U	NA	NA	0.0000385 U	NA	NA
SOWZS	HPCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0000385 U	NA	NA	0.0000385 U	NA	NA
SOWZS	OCDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0007 U	NA	NA	0.00055 U	NA	NA
SOWZS	TCDF	NA	NA	NA	NA	NA	NA	NA	R	R	NA	0.000095 F	NA	NA	0.00019 J	NA	NA
8270S	DIBENZOFURAN	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	0.17 U	0.175 U	0.17 U	0.17 U	0.17 U	0.065 J

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration.

TABLE 4 - 22
CRANSTON SITE
PRODUCTION AREA
SHALLOW SOIL
ORGANIC DATA

	AREA/SUB AREA	SWMU7/B7B		SWMU7/B7B		SWMU7/B7D1		SWMU7/B7D1		SWMU7/B7E1		SWMU7/B7F1		SWMU7/B7G1		SWMU7/B7H1		SWMU8/B8A		SWMU8/B8B		SWMU8/B8B		SWMU8/B8D1		SWMU8/B8F1		SWMU8/B8G1		SWMU8/B8H1	
	SAMPLE ID	B-7B*IB-1		B-7B*IB-2		B-7D1*II-1		B-DUP2*II-1		B-7E1*II-1		B-7F1*II-1		B-7G1*II-1		B-7H1*II-1		B-8A*IB-1		B-8B*IB-1		B-8B*IB-2		B-8D1*II-1		B-8F1*II-1		B-8G1*II-1		B-8H1*II-1	
	SAMPLE DATE	11/20/90		3/18/91		7/23/93		7/23/93		7/23/93		7/23/93		7/23/93		7/23/93		11/20/90		11/20/90		3/14/91		7/24/93		7/24/93		7/24/93		7/24/93	
	DEPTH RANGE (ft)	0 to 2		0 to 2		0 to 2		0 to 2		0 to 2		0 to 2		0 to 2		0 to 2		0 to 2		0 to 2		0 to 2		0 to 2		0 to 2		0 to 2		0 to 2	
		Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
VOLATILE ORGANICS																															
	HALOGENATED																														
8240S	CHLOROBENZENE	0.055	U	0.055	U	0.00255	U	0.00255	U	0.0026	U	0.0026	U	0.0026	U	0.0027	U	0.055	U	6.5	U	0.055	U	0.0026	U	0.0026	U	0.00265	U	0.00265	U
8240S	CHLOROFORM	0.055	U	0.055	U	0.00255	U	0.00255	U	0.0026	U	0.0026	U	0.0026	U	0.0027	U	0.055	U	6.5	U	0.055	U	0.0026	U	0.0026	U	0.00265	U	0.00265	U
8240S	METHYLENE CHLORIDE	0.165	U	0.06	U	0.00255	U	0.00255	U	0.0026	U	0.0026	U	0.0026	U	0.0027	U	0.135	U	6.5	U	0.055	U	0.0084	J	0.0087		0.0095		0.0089	
8240S	TRICHLOROFLUOROMETHANE	0.105	U	0.11	U	0.00255	U	0.00255	U	0.0026	U	0.0026	U	0.0026	U	0.0027	U	0.11	U	13.5	U	0.11	U	0.0026	U	0.0026	U	0.00265	U	0.00265	U
8240S	TETRACHLOROETHENE	0.055	U	0.055	U	0.00255	U	0.00255	U	0.0026	U	0.0026	U	0.0026	U	0.0027	U	0.055	U	6.5	U	0.055	U	0.0026	U	0.0026	U	0.00265	U	0.00265	U
	AROMATICS																														
8240S	ETHYLBENZENE	0.12		0.021	J	0.00255	U	0.00255	U	0.0026	U	0.0026	U	0.0026	U	0.0027	U	0.26		50		0.029	J	0.0026	U	0.0026	U	0.00265	U	0.00265	U
8240S	M&P-XYLENE	0.43		0.16		0.00255	U	0.021	J	0.0087		0.0026	U	0.0026	U	0.0027	U	1.1		400		0.14		0.015	J	0.007		0.006		0.0085	
8240S	O-XYLENE	0.11		0.046	J	0.00255	U	0.00255	U	0.0026	U	0.0026	U	0.0026	U	0.0027	U	0.33		120		0.05	J	0.0026	U	0.0026	U	0.00265	U	0.00265	U
8240S	STYRENE	0.049	J	0.055	U	0.00255	U	0.00255	U	0.0026	U	0.0026	U	0.0026	U	0.0027	U	0.055	U	6.5	U	0.055	U	0.0026	U	0.0026	U	0.00265	U	0.00265	U
8240S	TOLUENE	4.6	J	0.024	J	0.00255	U	0.00255	U	0.0026	U	0.0068	J	0.0026	U	0.0027	U	4.4	J	4.6	J	0.055	U	0.0026	U	0.007		0.00265	U	0.00265	U
SEMI-VOLATILE ORGANICS																															
	BASE NEUTRALS																														
	PAHs																														
8270S	2-METHYLNAPHTHALENE	5.5	U	0.55	U	0.17	U	0.17	U	0.17	U	0.063	J	0.17	U	0.038	J	0.55	U	5	U	0.55	U	0.17	U	0.17	U	0.094	J	0.175	U
8270S	ACENAPHTHENE	5.5	U	0.55	U	0.17	U	0.057	J	0.17	U	0.071	J	0.17	U	0.175	U	0.15	J	5	U	0.55	U	0.071	J	0.079	J	0.21	J	0.12	J
8270S	ACENAPHTHYLENE	5.5	U	0.55	U	0.17	U	0.17	U	0.17	U	0.066	J	0.17	U	0.175	U	0.55	U	5	U	0.55	U	0.17	U	0.14	J	0.175	U	0.175	U
8270S	ANTHRACENE	5.5	U	0.55	U	0.17	U	0.14	J	0.17	U	0.26	J	0.044	J	0.044	J	0.36	J	5	U	0.18	J	0.32	J	0.26	J	0.84		0.39	
8270S	BENZO(A)ANTHRACENE	5.5	U	0.55	U	0.115	U	0.15	J	0.12	U	0.74		0.12	U	0.22	J	1.2		1	J	0.6	J	1	J	1.2		3	J	1.1	J
8270S	BENZO(A)PYRENE	5.5	U	0.55	U	0.115	U	0.14	J	0.12	U	0.69		0.26	J	0.23	J	1.3		5	U	0.55	J	1.1	J	1.6		3.1	J	0.99	J
8270S	BENZO(B)FLUORANTHENE	5.5	U	0.55	U	0.027	J	0.18	J	0.12	U	1		0.41	J	0.36		2.1		1.9	J	0.9	J	1.4	J	2		4	J	1.2	J
8270S	BENZO(G,H,I)PERYLENE	5.5	U	0.55	U	0.17	U	0.17	U	0.17	U	0.35		0.13	J	0.16	J	0.97	J	5	U	0.45	J	0.7	J	0.87		1.8	J	0.49	J
8270S	BENZO(K)FLUORANTHENE	5.5	U	0.55	U	0.115	U	0.074	J	0.12	U	0.37		0.15	J	0.12	J	2.7		2.4	J	1.1		0.53	J	0.84		1.4	J	0.54	J
8270S	BIS(2-CHLOROETHYL)ETHER	5.5	U	0.55	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.175	U	0.55	U	5	U	0.55	U	0.17	U	0.17	U	0.175	U	0.175	U
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	5.5	U	0.55	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.175	U	0.55	U	5	U	0.55	U	0.59	J	0.29	J	0.49	J	0.061	J
8270S	CHRYSENE	5.5	U	0.55	U	0.17	U	0.15	J	0.17	U	0.85		0.23	J	0.24	J	1.4		1.2	J	0.66	J	1.2	J	1.8		3.3	J	1.1	J
8270S	DIBENZ(A,H)ANTHRACENE	5.5	U	0.55	U	0.1	U	0.1	U	0.105	U	0.11	J	0.105	U	0.046	J	0.3	J	5	U	0.55	U	0.105	U	0.26		0.105	U	0.105	U
8270S	FLUORANTHENE	5.5	U	0.31	J	0.17	U	0.47	J	0.17	U	1.9		0.46		0.43		2.4		1.8	J	1.3		1.8		1.2		4.1		2	
8270S	FLUORENE	5.5	U	0.55	U	0.17	U	0.053	J	0.17	U	0.085	J	0.17	U	0.175	U	0.096	J	5	U	0.55	U	0.079	J	0.099	J	0.18	J	0.13	J
8270S	INDENO(1,2,3-CD)PYRENE	5.5	U	0.55	U	0.1	U	0.045	J	0.105	U	0.33		0.13	J	0.13	J	0.9	J	5	U	0.32	J	0.67	J	0.92		1.7	J	0.54	J
8270S	NAPHTHALENE	5.5	U	0.092	J	0.17	U	0.17	U	0.17	U	0.078	J	0.17	U	0.033	J	0.095	J	0.68	J	0.55	U	0.17	U	0.049	J	0.06	J	0.175	U
8270S	PHENANTHRENE	5.5	U	0.55	U	0.17	U	0.52		0.17	U	1.2		0.18	J	0.14	J	1.2		1.1	J	0.77	J	1.2		0.65		2		1.4	
8270S	PYRENE	5.5	U	0.34	J	0.17	U	0.43	J	0.17	U	2		0.72	J	0.48		2.1		1.7	J	1.1		3.8	J	2.7		6.7		2.7	J
	PHTHALATES																														
8270S	BUTYLBENZYLPHTHALATE	5.5	U	0.55	U	0.17	U	0.17	U	0.17	U	0.17	U	0.053	J	0.096	J	0.11	J	5	U	0.55	U	0.8	J	0.25	J	0.16	J	0.042	J
8270S	DI-N-BUTYLPHTHALATE	5.5	U	0.55	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.175	U	0.55	U	5	U	0.55	U	0.069	J	0.045	J	0.069	J	0.062	J
8270S	DI-N-OCTYLPHTHALATE	5.5	U	0.55	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.175	U	0.55	U	5	U	0.55	U	0.17	U	0.17	U	0.175	U	0.175	U
8270S	DIMETHYLPHTHALATE	5.5	U	0.55	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.175	U	0.55	U	5	U	0.55	U	0.17	U	0.17	U	0.175	U	0.175	U
	HALOGENATED																														
8270S	1,2-DICHLOROBENZENE	5.5	U	0.55	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.175	U	0.55	U	5	U	0.12	J	0.17	U	0.17	U	0.175	U	0.175	U
8270S	1,4-DICHLOROBENZENE	5.5	U	0.55	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.175	U	0.55	U	5	U	0.55	U	0.17	U	0.17	U	0.175	U	0.175	U
8270S	4-CHLOROANILINE	5.5	U	0.55	U	0.335	U	0.335	U	0.345	U	0.34	U	0.345	U	0.17	J	0.55	U	5	U	0.55	U	0.345	U	0.076	J	0.64	J	0.345	U
	OTHER BASE NEUTRALS																														
8270S	2-NITROANILINE	26.5	U	2.75	U	0.16	J	0.088	J	0.9	U	0.9	U	0.35	J	0.066	J	2.7	U	26	U	2.8	U	0.9	U	0.2	J	0.044	J	0.9	U
8270S	NITROBENZENE	5.5	U	0.55	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.175	U	0.12	J	5	U	0.14	J	0.17	U	0.081	J	0.175	U	0.175	U
	ACID EXTRACTABLES																														
	PHENOLS																														
8270S	2,4-DIMETHYLPHENOL	5.5	U	0.55	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.175	U	0.55	U	5	U	0.55	U	0.17	U	0.11	J	0.175	U	0.175	U
8270S	3&4-METHYLPHENOL	NA		NA		0.023	J	0.17	U	0.17	U	0.17	U	0.17	U	0.053	J	NA		NA		NA		0.17	U	0.045	J	0.175	U	0.175	U
8270S	4-METHYLPHENOL	5.5	U	0.55	U	NA		NA		NA		NA		NA		NA		0.55	U	5	U	0.55	U	NA		NA		NA		NA	
8270S	PHENOL	5.5	U	0.55	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.175	U	0.55	U	5	U	0.55	U	0.17	U	0.17	U	0.175	U	0.175	U
	OTHER ACID EXTRACTABLES																														
8270S	ACETOPHENONE	5.5	U	0.55	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.175	U	0.55	U	5	U	0.55	U	0.17	U	0.048	J	0.175	U	0.175	U
8270S	ANILINE	5.5	U	0.55	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.23	J	0.55	U	5	U	0.55	U	0.17	U	0.17	U	0.175	U	0.175	U
8270S	BUTAZOLIDIN	26.5	U	2.75	U	NA		NA		NA		NA		NA		NA		2.7	U	26	U	2.8	U	NA		NA		NA		NA	
FINGERPRINT COMPOUNDS																															
8270S	IRGASAN DP-300	26.5	U	2.75	U	NA		NA		NA		NA		NA		NA		2.7	U	26	U	0.57	J	NA		NA		NA		0.175	U
8270S	TINUVIN 327	26.5	U	2.75	U	NA		NA		NA		NA		NA		NA		R		26	U	2.8	U	NA		NA		NA		NA	
8270S	TINUVIN 328	NA		NA		5.1		5.9		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
PCBs																															
8080S	PCB-1248	0.05	U	0.275	U	0.335	U	0.17	U	0.085	U	0.017	U	0.085	U	0.175	U	0.026	U	0.265	U	0.28	U	0.017	U	0.085	U	0.35	U	0.0175	U
8080S	PCB-1254	5.2		6		2.2	J	1.4		0.62		0.017	U	2.2		4.2	J	1.8		0.55	U	12	J	0.052		1.1		7.8		0.4	J
8080S	PCB-1260	0.105	U	0.55	U	6.1	J	2.7	J	0.83		0.017	U	0.085	U	0.175	U	0.05	U	0.55	U	0.55	U	0.017	U	0.085	U	0.35	U	0.0175	U
ORGANOCHLORINE PESTICIDES																															
8080S	4,4'-DDD	0.005	U	0.0275	U	0.0335	U	0.017	U	0.0085	U	0.0017	U	0.0085	U	0.0175	U	0.0026	U	0.0265	U	0.028	U	0.0017	U	0.0085	U	0.035	U	0.00175	U
8080S	4,4'-DDE	0.005	U	0.0275	U	0.0335	U	0.017	U	0.0085	U	0.0017	U	0.0085	U	0.0175	U	0.0026	U	0.0265	U	0.028	U	0.0017	U	0.0085	U	0.035	U	0.00175	U
8080S	4,4'-DDT	0.0105	U	0.055	U	0.0335	U	0.017	U	0.0085	U	0.0017	U	0.0085	U	0.0175	U	0.005	U	0.055	U	0.055	U	0.0017	U	0.0085	U	0.035	U	0.00175	U
8080S	ALDRIN	0.005	U	0.0275	U	0.0175	U	0.0085	U	0.0044	U	0.0009	U	0.0044	U	0.009	U	0.0026	U	0.0265	U	0.028	U	0.0009	U	0.0044	U	0.018	U	0.0009	U
8080S	ALPHA-BHC	0.005	U	0.0275	U	0.0175	U	0.0085	U	0.0044	U	0.0009	U	0.0044	U	0.009	U	0.0026	U	0.0265	U	0.028	U	0.0009	U	0.0044	U	0.018	U	0.0009	U
8080S	ALPHA-CHLORDANE	0.005	U	0.0275	U	0.0175	U	0.0085	U	0.0044	U	0.0025		0.0044	U	0.009	U	0.0026	U	0.0265	U	0.028	U	0.0009	U	0.0044	U	0.018	U	0.0009	U
8080S	DELTA-BHC	0.005	U	0.0275	U	0.0175	U	0.0085	U	0.0044	U	0.0009	U	0.0044	U	0.009	U	0.0026	U	0.0265	U	0.028	U	0.0009	U	0.0044	U	0.018	U	0.0009	U
8080S	ENDOSULFAN SULFATE	0.026	U	0.135	U	0.0335	U	0.017	U	0.0085	U	0.0017	U	0.0085	U	0.0175	U	0.013	U	0.13	U	0.14	U	0.0017	U	0.0085	U	0.035	U	0.00175	U
8080S	ENDRIN ALDEHYDE	0.0105	U	0.055	U	0.0335	U	0.017	U	0.0085	U	0.0017	U	0.0085	U	0.0175	U	0.005	U	0.055	U	0.055	U	0.0017	U	0.0085	U	0.035	U	0.00175	U
8080S	GAMMA-BHC	0.005	U	0.0275	U	0.0175	U	0.0085	U	0.0044	U	0.0009	U	0.0044	U	0.009	U	0.0026	U	0.0265	U	0.028	U	0.0009	U	0.0044	U	0.018	U	0.0009	U
8080S	GAMMA-CHLORDANE	0.005	U	0.0275	U	0.0175	U	0.0085	U	0.0099	J	0.0017	U	0.037	J	0.028	J	0.0026	U	0.0265	U	0.028	U	0.0009	U	0.0044	U	0.14	J	0.0009	U
8080S	HEPTACHLOR	0.005	U	0.014	J	0.0175	U	0.0085	U	0.0044	U	0.0009	U	0.0044	U	0.009	U	0.0026	U	0.0265	U	0.028	U	0.0009	U	0.0044	U	0.018	U	0.0009	U
8080S	HEPTACHLOR EPOXIDE	0.005	U	0.0275	U	0.0175	U	0.0085	U	0.0044	U	0.0009	U	0.0044	U	0.009	U	0.0026	U	0.0265	U	0.028	U	0.0009	U	0.0044	U	0.018	U	0.0009	U
8080S	KEPONE	0.005	U	0.0275	U	0.175	U	0.085	U	0.044	U	0.009	U	0.0044	U	0.09	U	0.0026	U	0.0265	U	0.028	U	0.009	U	0.044	U	0.18	U	0.009	U
8080S	METHOXYCHLOR	0.026	U	0.135	U	0.175	U	0.085	U	0.044	U	0.009	U	0.0044	U	1.2	J	0.013	U	0.13	U	0.14	U	0.009	U	0.044	U	0.96	J	3.8	
ORGANOPHOSPHORUS PESTICIDES																															
8140S	FAMPHUR	0.0062	J	0.14	U	0.17	U	0.17	U	0.17	U	0.17	U	0.17	U	0.175	U	0.135	U	0.27	U	0.14	U	0.17	U	0.17	U	0.175	U	0.175	U
8140S	METHYL PARATHION	0.008	U	0.0085	U	0.0085	U	0.0085	U	0.009	U	0.009	U	0.009	U	0.009	U	0.0056	J	0.016	U	0.0085	U	0.009	U	0.009	U	0.009	U	0.009	U
8140S	SULFOTEPP	0.0265	U	0.0275	U	0.0085	U	0.0085	U	0.009	U	0.009	U	0.009	U	0.009	U	0.027	U	0.055	U	0.028	U	0.009	U	0.009	U	0.009	U	0.009	U
HERBICIDES																															
8150S	2,4,5-TP (SILVEX)	0.009	U	0.0095	U	NA		NA		NA		NA		NA		NA		0.0085	U	0.009	U	0.006	J	NA		NA		NA		0.009	U
8150S	DINOSEB	0.008	U	0.0087	J	NA		NA		NA		NA		NA		NA		0.0075	U	0.0075	U	0.0085	U	NA		NA		NA		NA	
CHLORINATED DIOXINS AND FURANS																															
8270S	TRCDF	10.5	U	2.4		0	U	0	U	NA		NA		NA		NA		1.2	J	10.5	U	1.1	U	NA		NA		NA		0	U
SOWZS	1,2,3,4,6,7,8-HPCDD	NA		NA		0.000065	U	0.0000385	U	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		0.000145	U
SOWZS	HPCDD	NA		NA		0.000065	U	0.0000385	U	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		0.000145	U
SOWZS	OCDD	NA		NA		0.000385	U	0.00046	J	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		0.000435	U
SOWZS	TCDF	R		R		0.00007	U	0.00013	J	NA		NA		NA		NA		R		R		R		NA		NA		NA		0.000165	U
8270S	DIBENZOFURAN	5.5	U	0.55	U	0.17	U	0.035	J	0.17	U	0.087	J	0.17	U	0.175	U	0.068	J	5	U	0.06	J	0.035	J	0.054	J	0.11	J	0.051	J

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration.

TABLE 4 - 22
CRANSTON SITE
PRODUCTION AREA
SHALLOW SOIL
ORGANIC DATA

AREA/SUB AREA		ALL SWMUs AND AOC13 SUMMARY					AOI15/15A	AOI15/15B	AOI15/MW16S	AOI15/MW16S	AOI15 SUMMARY				
SAMPLE ID							SF-15A*II-1	SF-15B*II-1	SS-MW-16S*IB-1	SS-MW-16S*IB-2					
SAMPLE DATE							8/10/93	8/10/93	12/5/90	3/14/91					
DEPTH RANGE (ft)		Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected	.5 to 1 Result Q	.5 to 1 Result Q	.5 to 1 Result Q	.5 to 1 Result Q	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
VOLATILE ORGANICS															
	HALOGENATED														
8240S	CHLOROBENZENE	7	0.0917	0.203	0.28	0.032	0.00255 U	0.00255 U	0.065 U	0.05 U	0		0.03		
8240S	CHLOROFORM	1	0.034	0.196	0.034	0.034	0.00255 U	0.00255 U	0.065 U	0.05 U	0		0.03		
8240S	METHYLENE CHLORIDE	6	0.00775	0.269	0.0095	0.0054	0.00255 U	0.00255 U	0.065 U	0.17 U	0		0.06		
8240S	TRICHLOROFLUOROMETHANE	3	0.23	0.413	0.33	0.071	0.00255 U	0.00255 U	0.13 U	0.105 U	0		0.06		
8240S	TETRACHLOROETHENE	1	0.069	0.197	0.069	0.069	0.00255 U	0.00255 U	0.065 U	0.05 U	0		0.03		
	AROMATICS														
8240S	ETHYLBENZENE	10	5.06	1.29	50	0.0063	0.00255 U	0.00255 U	0.065 U	0.05 U	0		0.03		
8240S	M&P-XYLENE	27	14.9	10.1	400	0.006	0.00255 U	0.00255 U	0.065 U	0.0082 J	1	0.0082	0.0196	0.0082	0.0082
8240S	O-XYLENE	19	6.37	3.03	120	0.0093	0.00255 U	0.00255 U	0.065 U	0.05 U	0		0.03		
8240S	STYRENE	2	0.044	0.196	0.049	0.039	0.00255 U	0.00255 U	0.065 U	0.05 U	0		0.03		
8240S	TOLUENE	18	0.82	0.393	4.6	0.0068	0.00255 U	0.00255 U	0.065 U	0.014 J	1	0.014	0.021	0.014	0.014
SEMI-VOLATILE ORGANICS															
	BASE NEUTRALS														
	PAHs														
8270S	2-METHYLNAPHTHALENE	4	0.144	1.26	0.38	0.038	0.17 U	0.17 U	0.6 U	0.55 U	0		0.373		
8270S	ACENAPHTHENE	10	0.121	1.24	0.21	0.057	0.17 U	0.03 J	0.6 U	0.55 U	1	0.03	0.338	0.03	0.03
8270S	ACENAPHTHYLENE	5	0.0954	1.26	0.18	0.043	0.046 J	0.2 J	0.6 U	0.55 U	2	0.123	0.349	0.2	0.046
8270S	ANTHRACENE	24	0.312	0.881	1.6	0.034	0.039 J	0.23 J	0.6 U	0.55 U	2	0.135	0.355	0.23	0.039
8270S	BENZO(A)ANTHRACENE	28	0.988	1.14	3.1	0.15	0.2 J	0.89	0.6 U	0.14 J	3	0.41	0.458	0.89	0.14
8270S	BENZO(A)PYRENE	27	0.941	1.29	3.1	0.024	0.25	0.96	0.6 U	0.11 J	3	0.44	0.48	0.96	0.11
8270S	BENZO(B)FLUORANTHENE	30	1.41	1.57	4.3	0.027	0.36	1.4	0.6 U	0.22 J	3	0.66	0.645	1.4	0.22
8270S	BENZO(G,H,I)PERYLENE	21	0.832	1.35	2.9	0.13	0.16 J	0.58 J	0.6 U	0.55 U	2	0.37	0.473	0.58	0.16
8270S	BENZO(K)FLUORANTHENE	27	1.46	1.5	5.5	0.074	0.12 J	0.57	0.6 U	0.29 J	3	0.327	0.395	0.57	0.12
8270S	BIS(2-CHLOROETHYL)ETHER	1	0.68	1.28	0.68	0.68	0.17 U	0.17 U	0.6 U	0.55 U	0		0.373		
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	16	1.08	1.09	4.1	0.061	0.13	0.8	0.6 U	0.55 U	2	0.465	0.52	0.8	0.13
8270S	CHRYSENE	28	1.11	1.24	3.3	0.15	0.36	1.5	0.6 U	0.18 J	3	0.68	0.66	1.5	0.18
8270S	DIBENZ(A,H)ANTHRACENE	10	0.253	1.23	0.68	0.046	0.053 J	0.18 J	0.6 U	0.55 U	2	0.117	0.346	0.18	0.053
8270S	FLUORANTHENE	33	1.6	1.6	8.4	0.051	0.62	2.2	0.6 U	0.29 J	3	1.04	0.928	2.2	0.29
8270S	FLUORENE	12	0.0941	1.21	0.18	0.048	0.17 U	0.1 J	0.6 U	0.55 U	1	0.1	0.355	0.1	0.1
8270S	INDENO(1,2,3-CD)PYRENE	21	0.68	1.33	2.3	0.045	0.17 J	0.62 J	0.6 U	0.55 U	2	0.395	0.485	0.62	0.17
8270S	NAPHTHALENE	14	0.197	0.83	0.68	0.033	0.17 U	0.17 U	0.6 U	0.55 U	0		0.373		
8270S	PHENANTHRENE	28	0.967	1.15	5	0.093	0.28 J	1.2	0.6 U	0.16 J	3	0.547	0.56	1.2	0.16
8270S	PYRENE	32	1.76	1.82	6.7	0.061	0.54	2.1	0.6 U	0.27 J	3	0.97	0.878	2.1	0.27
	PHTHALATES														
8270S	BUTYLBENZYLPHTHALATE	13	2.93	1.83	33	0.042	0.22 J	0.46	0.6 U	0.55 U	2	0.34	0.458	0.46	0.22
8270S	DI-N-BUTYLPHTHALATE	8	0.394	0.999	1.3	0.045	0.17 U	0.17 U	0.6 U	0.55 U	0		0.373		
8270S	DI-N-OCTYLPHTHALATE	0		1.28			0.17 U	0.036 J	0.6 U	0.55 U	1	0.036	0.339	0.036	0.036
8270S	DIMETHYLPHTHALATE	1	0.25	1.21	0.25	0.25	0.17 U	0.17 U	0.6 U	0.55 U	0		0.373		
	HALOGENATED														
8270S	1,2-DICHLOROBENZENE	2	0.12	1.25	0.12	0.12	0.17 U	0.17 U	0.6 U	0.55 U	0		0.373		
8270S	1,4-DICHLOROBENZENE	1	0.24	1.27	0.24	0.24	0.17 U	0.17 U	0.6 U	0.55 U	0		0.373		
8270S	4-CHLOROANILINE	5	0.195	1.32	0.64	0.045	0.32 J	0.335 U	0.6 U	0.55 U	1	0.32	0.451	0.32	0.32
	OTHER BASE NEUTRALS														
8270S	2-NITROANILINE	8	0.262	8.25	0.89	0.044	0.85 U	0.85 U	3.1 U	2.65 U	0		1.86		
8270S	NITROBENZENE	3	0.114	1.25	0.14	0.081	0.17 U	0.17 U	0.6 U	0.55 U	0		0.373		
	ACID EXTRACTABLES														
	PHENOLS														
8270S	2,4-DIMETHYLPHENOL	1	0.11	1.27	0.11	0.11	0.17 U	0.17 U	0.6 U	0.55 U	0		0.373		
8270S	3&4-METHYLPHENOL	5	0.197	0.179	0.77	0.023	0.17 U	0.17 U	NA	NA	0		0.17		
8270S	4-METHYLPHENOL	1	0.24	1.97	0.24	0.24	NA	NA	0.6 U	0.55 U	0		0.575		
8270S	PHENOL	1	0.63	1.28	0.63	0.63	0.17 U	0.17 U	0.6 U	0.55 U	0		0.373		
	OTHER ACID EXTRACTABLES														
8270S	ACETOPHENONE	1	0.048	1.27	0.048	0.048	0.17 U	0.17 U	0.6 U	0.55 U	0		0.373		
8270S	ANILINE	1	0.23	1.28	0.23	0.23	0.17 U	0.17 U	0.6 U	0.55 U	0		0.373		
8270S	BUTAZOLIDIN	1	5.2	9.98	5.2	5.2	NA	NA	3.1 U	2.65 U	0		2.88		
FINGERPRINT COMPOUNDS															
8270S	IRGASAN DP-300	3	2.06	9.42	4.2	0.57	NA	NA	3.1 U	2.65 U	0		2.88		
8270S	TINUVIN 327	1	5.2	9.27	5.2	5.2	NA	NA	3.1 U	2.65 U	0		2.88		
8270S	TINUVIN 328	3	4.53	4.53	5.9	2.6	NA	NA	NA	NA	0				
PCBs															
8080S	PCB-1248	39	134	51.9	4500	0.02	0.017 U	0.0335 U	0.0065 U	0.0055 U	0		0.0158		
8080S	PCB-1254	94	15.3	15.8	84	0.043	0.61	0.0335 U	0.0125 U	0.011 U	1	0.61	0.167	0.61	0.61
8080S	PCB-1260	7	2.31	2.94	6.1	0.13	0.017 U	0.0335 U	0.0125 U	0.011 U	0		0.0185		
ORGANOCHLORINE PESTICIDES															
8080S	4,4'-DDD	1	0.0033	0.0399	0.0033	0.0033	0.0079 J	0.044 J	0.00065 U	0.00055 U	2	0.026	0.0133	0.044	0.0079
8080S	4,4'-DDE	0		0.0398			0.0017 U	0.02 J	0.00065 U	0.00055 U	1	0.02	0.00573	0.02	0.02
8080S	4,4'-DDT	0		0.0589			0.085 J	0.042 J	0.00125 U	0.0011 U	2	0.0635	0.0323	0.085	0.042
8080S	ALDRIN	1	0.0035	0.0302	0.0035	0.0035	0.00085 U	0.00175 U	0.00065 U	0.00055 U	0		0.00095		
8080S	ALPHA-BHC	2	0.00575	0.0303	0.0099	0.0016	0.00085 U	0.00175 U	0.00065 U	0.00055 U	0		0.00095		
8080S	ALPHA-CHLORDANE	2	0.0061	0.0304	0.0097	0.0025	0.00085 U	0.036 J	0.00065 U	0.0083	2	0.0222	0.0115	0.036	0.0083
8080S	DELTA-BHC	1	0.0024	0.0302	0.0024	0.0024	0.00085 U	0.00175 U	0.00065 U	0.0047	1	0.0047	0.00199	0.0047	0.0047
8080S	ENDOSULFAN SULFATE	0		0.116			0.02 J	0.036	0.0032 U	0.0027 U	2	0.028	0.0155	0.036	0.02
8080S	ENDRIN ALDEHYDE	1	0.001	0.0589	0.001	0.001	0.0017 U	0.00335 U	0.00125 U	0.0025	1	0.0025	0.0022	0.0025	0.0025
8080S	GAMMA-BHC	2	0.0033	0.0303	0.0033	0.0033	0.00085 U	0.00175 U	0.00065 U	0.0015	1	0.0015	0.00119	0.0015	0.0015
8080S	GAMMA-CHLORDANE	7	0.279	0.0659	1.7	0.0075	0.00085 U	0.028 J	0.00065 U	0.00055 U	1	0.028	0.00751	0.028	0.028
8080S	HEPTACHLOR	1	0.014	0.0299	0.014	0.014	0.00085 U	0.00175 U	0.00065 U	0.00055 U	0		0.00095		
8080S	HEPTACHLOR EPOXIDE	0		0.0302			0.00085 U	0.024 J	0.00065 U	0.022	2	0.023	0.0119	0.024	0.022
8080S	KEPONE	1	0.015	0.127	0.015	0.015	0.0085 U	0.0175 U	0.00065 U	0.00055 U	0		0.0068		
8080S	METHOXYCHLOR	7	0.987	0.354	3.6	0.12	0.0085 U	0.0175 U	0.0032 U	0.0027 U	0		0.00798		
ORGANOPHOSPHORUS PESTICIDES															
8141S	FAMPHUR	2	0.0111	0.147	0.016	0.0062	0.17 U	0.17 U	0.16 U	0.135 U	0		0.159		
8141S	METHYL PARATHION	2	0.00605	0.00851	0.0065	0.0056	0.0085 U	0.0085 U	0.0046 J	0.008 U	1	0.0046	0.0074	0.0046	0.0046
8141S	SULFOTEPP	1	0.0094	0.0205	0.0094	0.0094	0.0085 U	0.0085 U	0.032 U	0.027 U	0		0.019		
HERBICIDES															
8151S	2,4,5-TP (SILVEX)	1	0.006	0.00905	0.006	0.006	0.0085 U	0.0085 U	0.011 U	0.009 U	0		0.00925		
8151S	DINOSEB	3	0.00503	0.00773	0.0087	0.0024	NA	NA	0.0095 U	0.008 U	0		0.00875		
CHLORINATED DIOXINS AND FURANS															
8270S	TRCDF	8	1.99	2.93	3.9	0.4	NA	NA	1.25 U	1.05 U	0		1.15		
SOWZS	1,2,3,4,6,7,8-HPCDD	0		0.0000651			0.00007 F	0.0000345 U	NA	NA	1	0.00007	0.0000523	0.00007	0.00007
SOWZS	HPCDD	0		0.0000651			0.00007 F	0.0000345 U	NA	NA	1	0.00007	0.0000523	0.00007	0.00007
SOWZS	OCDD	1	0.00046	0.000506	0.00046	0.00046	0.00078 J	0.00044 J	NA	NA	2	0.00061	0.00061	0.00078	0.00044
SOWZS	TCDF	3	0.000138	0.00013	0.00019	0.000095	0.000012 U	0.000012 U	R	R	0		0.000012		
8270S	DIBENZOFURAN	12	0.0713	1.2	0.13	0.035	0.17 U	0.033 J	0.6 U	0.55 U	1	0.033	0.338	0.033	0.033

All results in mg/kg (ppm).

All undetected results listed at half-detection limit.

U - Undetected.

J - Estimated result.

R - Rejected result.

NA - Not analyzed.

F - Estimated maximum concentration.

TABLE 4-23
CRANSTON SITE
PRODUCTION AREA
DEEP SOIL
ORGANIC DATA

7/25/95 4:56 PM

	AREA/SUB AREA	SWMU2/B2G2		SWMU3/B3C		SWMU3/B3E2		SWMU3/B3G2		SWMU3/B3H2		SWMU7/B7A		SWMU7/B7H2		SWMU8/B8E2		SWMU8/B8G2		SWMU8/B8H2		SWMU11/B11A		SWMU11/B11B		SWMU11/B11B		SWMU2/B2E3		SWMU2/B2G3		SWMU3/B3I3	
	SAMPLE ID	B-2G2*II-1		B-3C*IB-2		B-3E2*II-1		B-3G2*II-1		B-3H2*II-1		B-7A*IB-1		B-7H2*II-1		B-8E2*II-1		B-8G2*II-1		B-8H2*II-1		B-11A*IB-1		B-11B*IB-1		B-11B*IB-2		B-2E3*II-1		B-2G3*II-1		B-3I3*II-1	
	SAMPLE DATE	7/9/93		3/18/91		7/12/93		7/12/93		7/12/93		11/20/90		7/23/93		7/24/93		7/24/93		7/24/93		12/6/90		11/20/90		3/15/91		7/9/93		7/9/93		7/13/93	
	DEPTH RANGE (ft)	2 to 4		2 to 4		2 to 4		2 to 4		2 to 4		2 to 4		2 to 4		2 to 4		2 to 4		2 to 4		3 to 5		3 to 7		3 to 7		4 to 6		4 to 6		4 to 6	
		Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
VOLATILE ORGANICS																																	
	HALOGENATED																																
8240S	CHLOROBENZENE	NA		0.055	U	0.0026	U	0.00265	U	0.0026	U	0.05	U	0.0028	U	0.00255	U	0.0026	U	0.00265	U	6.5	U	27	U	6.5	U	NA		0.0026	U	0.00265	U
8240S	METHYLENE CHLORIDE	NA		0.155	U	0.006		0.0075		0.0067		0.085	U	0.0028	U	0.0092		0.0094	J	0.0084	J	6.5	U	27	U	6.5	U	NA		0.0026	U	0.00265	U
	AROMATICS																																
8240S	ETHYLBENZENE	NA		0.055	U	0.0026	U	0.018		0.0026	U	0.04	J	0.0028	U	0.00255	U	0.0026	U	0.00265	U	18	J	29	J	14		NA		0.0026	U	0.00265	U
8240S	M&P-XYLENE	NA		0.055	U	0.0026	U	0.048	J	0.0056	J	0.21		0.0028	U	0.016		0.028	J	0.00265	U	59		120		53		NA		0.0026	U	0.00265	U
8240S	O-XYLENE	NA		0.055	U	0.0026	U	0.018		0.0026	U	0.1		0.0028	U	0.00255	U	0.013	J	0.00265	U	14	J	27	J	11	J	NA		0.0026	U	0.00265	U
8240S	STYRENE	NA		0.055	U	0.0026	U	0.029		0.0026	U	0.05	U	0.0028	U	0.00255	U	0.0026	U	0.00265	U	6.5	U	27	U	6.5	U	NA		0.0026	U	0.00265	U
8240S	TOLUENE	NA		0.041	J	0.0026	U	0.011		0.0026	U	0.53	J	0.0028	U	0.00255	U	0.0056	J	0.00265	U	1200		700	J	530	J	NA		0.0026	U	0.00265	U
	KETONE/ALDEHYDES																																
8240S	2-BUTANONE	NA		0.11	U	0.013	U	0.013	U	0.013	U	0.105	U	0.014	U	0.013	U	0.013	U	0.013	U	13	U	55	U	13.5	U	NA		0.013	U	0.013	U
8240S	ACETONE	NA		0.11	U	0.013	U	0.013	U	0.013	U	0.105	U	0.014	U	0.013	U	0.013	U	0.013	U	13	U	55	U	13.5	U	NA		0.013	U	0.013	U
	OTHER VOLATILE ORGANICS																																
8240S	N-OCTANE	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
824DS	1,4-DIOXANE	NA		5.5	U	NA		NA		NA		5	U	NA		NA		NA		NA		5.5	U	5	U	5.5	U	NA		NA		NA	
SEMI-VOLATILE ORGANICS																																	
	BASE NEUTRALS																																
	PAHs																																
8270S	ACENAPHTHENE	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.185	U	0.17	U	1.7	U	0.049	J	0.5	U	5.5	U	0.5	U	0.175	U	0.17	U	0.175	U
8270S	ANTHRACENE	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.185	U	0.088	J	1.7	U	0.14	J	0.5	U	5.5	U	0.21	J	0.175	U	0.17	U	0.093	J
8270S	BENZO(A)ANTHRACENE	0.15	J	0.55	U	0.12	U	0.12	U	0.12	U	0.55	U	0.14	J	0.22	J	0.57	J	0.45		0.5	U	5.5	U	0.31	J	0.12	U	0.12	U	0.5	
8270S	BENZO(A)PYRENE	0.19	J	0.55	U	0.12	U	0.12	U	0.031	J	0.55	U	0.14	J	0.23	J	0.56	J	0.4		0.5	U	5.5	U	0.5	U	0.024	J	0.024	J	0.49	J
8270S	BENZO(B)FLUORANTHENE	0.31		0.55	U	0.12	U	0.028	J	0.047	J	0.55	U	0.23	J	0.3	J	0.67	J	0.52		0.5	U	5.5	U	0.41	J	0.036	J	0.041	J	0.75	J
8270S	BENZO(G,H,I)PERYLENE	0.14	J	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.12	J	0.17	U	1.7	U	0.26	J	0.5	U	5.5	U	0.5	U	0.175	U	0.17	U	0.27	J
8270S	BENZO(K)FLUORANTHENE	0.11	J	0.55	U	0.12	U	0.12	U	0.12	U	0.55	U	0.077	J	0.115	U	1.2	U	0.22	J	0.5	U	5.5	U	0.49	J	0.12	U	0.12	U	0.23	J
8270S	CHRYSENE	0.23	J	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.16	J	0.25	J	0.66	J	0.46		0.5	U	5.5	U	0.38	J	0.175	U	0.17	U	0.47	
8270S	DIBENZ(A,H)ANTHRACENE	0.11	U	0.55	U	0.105	U	0.105	U	0.105	U	0.55	U	0.11	U	0.1	U	1.05	U	0.066	J	0.5	U	5.5	U	0.5	U	0.105	U	0.105	U	0.105	U
8270S	FLUORANTHENE	0.38		0.31	J	0.17	U	0.175	U	0.054	J	0.083	J	0.31	J	0.34		1.1	J	0.94		0.1	J	1.2	J	0.81	J	0.043	J	0.17	U	0.88	
8270S	FLUORENE	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.185	U	0.061	J	1.7	U	0.054	J	0.5	U	5.5	U	0.5	U	0.175	U	0.17	U	0.175	U
8270S	INDENO(1,2,3-CD)PYRENE	0.15	J	0.55	U	0.105	U	0.105	U	0.105	U	0.55	U	0.11	J	0.1	U	1.05	U	0.24		0.5	U	5.5	U	0.5	U	0.105	U	0.105	U	0.28	J
8270S	2-METHYLNAPHTHALENE	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.185	U	0.081	J	1.7	U	0.175	U	0.5	U	5.5	U	0.5	U	0.175	U	0.17	U	0.175	U
8270S	NAPHTHALENE	0.18	U	0.089	J	0.17	U	0.175	U	0.17	U	0.059	J	0.185	U	0.029	J	1.7	U	0.175	U	0.26	J	0.68	J	0.5	U	0.175	U	0.17	U	0.175	U
8270S	PHENANTHRENE	0.19	J	0.55	U	0.17	U	0.175	U	0.17	U	0.046	J	0.079	J	0.31	J	0.58	J	0.5		0.075	J	1	J	0.75	J	0.175	U	0.17	U	0.4	
8270S	PYRENE	0.34	J	0.37	J	0.17	U	0.175	U	0.057	J	0.11	J	0.29	J	0.66	J	1.1	J	0.95		0.12	J	5.5	U	0.74	J	0.042	J	0.17	U	1.4	
	PHTHALATES																																
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	0.43		0.55	U	0.13	J	0.16	J	0.49		0.55	U	0.24	U	1.1	J	2.2	J	0.51		1.85	U	5.5	U	0.5	U	0.2	J	0.073	J	0.49	
8270S	BUTYLBENZYLPHTHALATE	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.13	J	0.185	U	0.37	J	1.7	U	0.044	J	0.5	U	5.5	U	0.5	U	0.175	U	0.17	U	0.175	U
8270S	DI-N-BUTYLPHTHALATE	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.049	J	0.185	U	0.042	J	1.7	U	0.048	J	0.5	U	5.5	U	0.5	U	0.175	U	0.17	U	0.175	U
8270S	DIETHYLPHTHALATE	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.185	U	0.17	U	1.7	U	0.175	U	0.5	U	0.67	J	0.5	U	0.175	U	0.17	U	0.175	U
	HALOGENATED																																
8270S	3,3'-DICHLOROBENZIDINE	0.36	U	1.1	U	0.345	U	0.35	U	0.345	U	1.05	U	0.73		0.335	U	3.45	U	0.35	U	1.05	U	10.5	U	1.05	U	0.345	U	0.345	U	0.345	U
8270S	1,2-DICHLOROBENZENE	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.185	U	0.17	U	1.7	U	0.175	U	0.5	U	5.5	U	0.76	J	0.175	U	0.17	U	0.175	U
8270S	BIS(2-CHLOROETHYL)ETHER	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.185	U	0.17	U	1.7	U	0.175	U	0.5	U	5.5	U	0.5	U	0.175	U	0.17	U	0.175	U
8270S	1,2,4-TRICHLOROBENZENE	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.185	U	0.17	U	1.7	U	0.175	U	0.19	J	5.5	U	0.64	J	0.175	U	0.17	U	0.175	U
	OTHER BASE NEUTRALS																																
8270S	2-NITROANILINE	0.9	U	2.75	U	0.9	U	0.9	U	0.9	U	2.65	U	0.95	U	0.85	U	9	U	0.9	U	2.6	U	26.5	U	2.6	U	0.9	U	0.9	U	0.9	U
8270S	4-CHLOROANILINE	0.36	U	0.55	U	0.345	U	0.35	U	0.345	U	0.55	U	0.1	J	0.335	U	0.36	J	0.042	J	0.5	U	5.5	U	0.5	U	0.345	U	0.345	U	0.345	U
8270S	ANILINE	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.21	J	0.17	U	1.7	U	0.175	U	0.5	U	5.5	U	0.5	U	0.175	U	0.17	U	0.175	U
8270S	NITROBENZENE	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.185	U	0.17	U	1.7	U	0.175	U	0.5	U	5.5	U	0.28	J	0.175	U	0.17	U	0.175	U
8270S	P-PHENYLENEDIAMINE	0.9	U	2.75	U	0.9	U	0.9	U	0.9	U	2.65	U	0.95	U	0.85	U	9	U	0.9	U	2.6	U	26.5	U	2.6	U	0.9	U	0.9	U	0.9	U
8270S	ACETOPHENONE	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.185	U	0.17	U	1.7	U	0.175	U	0.5	U	5.5	U	0.5	U	0.175	U	0.17	U	0.175	U
	ACID EXTRACTABLES																																
	PHENOLS																																
8270S	2,4-DICHLOROPHENOL	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.185	U	0.17	U	1.7	U	0.175	U	3.8		6.2	J	3.4		0.175	U	0.17	U	0.175	U
8270S	2,4-DIMETHYLPHENOL	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.185	U	0.17	U	1.7	U	0.175	U	0.5	U	5.5	U	0.5	U	0.175	U	0.17	U	0.175	U
8270S	2-METHYLPHENOL	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.185	U	0.17	U	1.7	U	0.175	U	0.5	U	5.5	U	0.5	U	0.175	U	0.17	U	0.175	U
8270S	2-NITROPHENOL	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.185	U	0.17	U	1.7	U	0.175	U	0.5	U	5.5	U	0.5	U	0.175	U	0.17	U	0.175	U
8270S	4-METHYLPHENOL	NA		0.55	U	NA		NA		NA		0.1	J	NA		NA		NA		NA		0.5	U	5.5	U	0.5	U	NA		NA		NA	
8270S	PHENOL	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.185	U	0.17	U	1.7	U	0.175	U	0.5	U	5.5	U	0.54	J	0.175	U	0.17	U	0.175	U
8270S	2,6-DICHLOROPHENOL	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.185	U	0.17	U	1.7	U	0.175	U	0.5	U	5.5	U	0.5	U	0.175	U	0.17	U	0.175	U
8270S	3&4-METHYLPHENOL	0.026	J	NA		0.88		0.38		1.2		NA		0.51		0.17	U	1.7	U	0.175	U	NA		NA		NA		0.175	U	0.17	U	0.175	U
FINGERPRINT COMPOUNDS																																	
8270S	IRGASAN DP-300	NA		2.75	U	NA		NA		NA		2.65	U	NA		NA		NA		NA		84	J	280		45	J	NA		NA		NA	
8270S	TINUVIN 327	NA		2.75	U	NA		NA		NA		2.65	U	NA		NA		NA		NA		2.6	U	26.5	U	2.6	U	NA		NA		NA	
8270S	TINUVIN 328	NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA		NA	
PCBs																																	
8080S	PCB-1254	2.4		1.4		0.44		1.2	J	3		1	U	1.6	J	0.26		0.95		0.21		0.105	U	1.05	U	9		0.12		0.017	U	0.2	J
8080S	PCB-1260	0.09	U	0.11	U	1.81	D	0.0175	U	0.0175	U	13	J	0.09	U	0.017	U	0.085	U	0.0175	U	0.105	U	1.05	U	0.5	U	0.0175	U	0.017	U	0.0175	U
ORGANOCHLORINE PESTICIDES																																	
8080S	4,4'-DDD	0.009	U	0.0055	U	0.0017	U	0.00175	U	0.00175	U	0.05	U	0.009	U	0.0017	U	0.0085	U	0.00175	U	0.005	U	0.05	U	0.026	U	0.00175	U	0.0017	U	0.00175	U
8080S	4,4'-DDE	0.009	U	0.0055	U	0.0017	U	0.00175	U	0.00175	U	0.05	U	0.009	U	0.0017	U	0.0085	U	0.00175	U	0.005	U	0.71	J	0.026	U	0.00175	U	0.0017	U	0.00175	U
8080S	4,4'-DDT	0.009	U	0.011	U	0.0017	U	0.00175	U	0.00175	U	0.1	U	0.009	U	0.0017	U	0.0085	U	0.00175	U	0.0105	U	0.35		0.05	U	0.00175	U	0.0017	U	0.00175	U
8080S	ALDRIN	0.0046	U	0.0055	U	0.0009	U	0.0009	U	0.0009	U	0.44	J	0.0047	U	0.00085	U	0.0044	U	0.0009	U	0.005	U	0.05	U	0.026	U	0.0009	U	0.0009	U	0.0009	U
8080S	ALPHA-BHC	0.0046	U	0.018		0.0009	U	0.0009	U	0.0009	U	0.05	U	0.0047	U	0.00085	U	0.0044	U	0.0009	U	0.005	U	0.05	U	0.026	U	0.0009	U	0.0009	U	0.0009	U
8080S	ALPHA-CHLORDANE	0.0046	U	0.0055	U	0.0009	U	0.0009	U	0.0009	U	0.05	U	0.0047	U	0.00085	U	0.0044	U	0.0009	U	0.005	U	0.05	U	0.026	U	0.0009	U	0.0009	U	0.0009	U
8080S	BETA-BHC	0.0046	U	0.0055	U	0.0009	U	0.0009	U	0.0009	U	0.05	U	0.0047	U	0.00085	U	0.0044	U	0.0009	U	0.005	U	0.05	U	0.026	U	0.0009	U	0.0009	U	0.0009	U
8080S	CHLOROBENZILATE	0.046	U	NA		0.009	U	0.009	U	0.009	U	NA		0.047	U	0.0085	U	0.044	U	0.009	U	NA		NA		NA		0.009	U	0.009	U	0.009	U
8080S	DELTA-BHC	0.0046	U	0.0055	U	0.0009	U	0.0009	U	0.0009	U	0.05	U	0.047	U	0.00085	U	0.0044	U	0.0009	U	0.005	U	0.05	U	0.026	U	0.0009	U	0.0009	U	0.0009	U
8080S	ENDOSULFAN SULFATE	0.009	U	0.0275	U	0.0017	U	0.00175	U	0.00175	U	0.255	U	0.009	U	0.0017	U	0.0085	U	0.00175	U	0.026	U	0.255	U	0.13	U	0.00175	U	0.0017	U	0.00175	U
8080S	ENDRIN ALDEHYDE	0.009	U	0.011	U	0.0017	U	0.00175	U	0.00175	U	0.1	U	0.009	U	0.0017	U	0.0085	U	0.00175	U	0.0105	U	0.105	U	0.05	U	0.00175	U	0.0017	U	0.00175	U
8080S	GAMMA-BHC	0.0046	U	0.0055	U	0.0009	U	0.0009	U	0.0009	U	0.05	U	0.0047	U	0.00085	U	0.0044	U	0.0009	U	0.005	U	0.05	U	0.026	U	0.0009	U	0.0009	U	0.0009	U
8080S	GAMMA-CHLORDANE	0.0046	U	0.0055	U	0.0009	U	0.0009	U	0.0009	U	0.05	U	0.028	J	0.0027	J	0.024	J	0.0009	U	0.005	U	0.05	U	0.026	U	0.0009	U	0.0009	U	0.0009	U
8080S	HEPTACHLOR	0.0046	U	0.0055	U	0.0009	U	0.0009	U	0.0009	U	0.05	U	0.0047	U	0.00085	U	0.0044	U	0.0009	U	0.005	U	0.05	U	0.042	J	0.0009	U	0.0009	U	0.0009	U
8080S	HEPTACHLOR EPOXIDE	0.0046	U	0.0055	U	0.0009	U	0.0009	U	0.0009	U	0.05	U	0.0047	U	0.00085	U	0.0044	U	0.0009	U	0.005	U	0.05	U	0.026	U	0.0009	U	0.0009	U	0.0009	U
8080S	ISODRIN	0.009	U	0.0055	U	0.0017	U	0.00175	U	0.00175	U	0.05	U	0.009	U	0.0017	U	0.0085	U	0.00175	U	0.005	U	0.22		0.026	U	0.00175	U	0.0017	U	0.00175	U
8080S	METHOXYCHLOR	0.046	U	0.0275	U	0.009	U	0.009	U	0.056	J	0.255	U	0.47	U	0.032	J	0.044	U	0.44	D	0.026	U	0.255	U	0.13	U	0.009	U	0.009	U	0.033	J
ORGANOPHOSPHORUS PESTICIDES																																	
8142S	DISULFOTON	0.07	U	0.055	U	0.065	U	0.07	U	0.07	U	0.055	U	0.07	U	0.065	U	0.07	U	0.07	U	0.05	U	R		0.055	U	0.065	U	0.07	U	0.07	U
8142S	ETHYL PARATHION	0.018	U	0.0415	U	0.017	U	0.0175	U	0.017	U	0.0395	U	0.0185	U	0.017	U	0.017	U	0.0175	U	0.039	U	R		0.0405	U	0.0175	U	0.017	U	0.0175	U
8142S	METHYL PARATHION	0.009	U	0.0085	U	0.009	U	0.009	U	0.009	U	0.007	J	0.0095	U	0.0085	U	0.009	U	0.009	U	0.008	U	R		0.008	U	0.009	U	0.009	U	0.009	U
HERBICIDES																																	
8151S	2,4,5-T	NA		0.011	U	NA		NA		NA		0.01	U	NA		NA		NA		NA		0.0105	U	0.01	U	0.0105	U	NA		0.009	U	NA	
8151S	2,4,5-TP (SILVEX)	NA		0.0095	U	NA		NA		NA		0.0085	U	NA		NA		NA		NA		0.009	U	0.0085	U	0.0072	J	NA		0.009	U	NA	
8151S	2,4-D	NA		0.065	U	NA		NA		NA		0.06	U	NA		NA		NA		NA		0.065	U	0.0082	J	0.016	J	NA		0.037	J	NA	
8151S	DINOSEB	NA		0.0054	J	NA		NA		NA		0.0075	U	NA		NA		NA		NA		0.008	U	0.0075	U	0.008	U	NA		NA		NA	
CHLORINATED DIOXINS AND FURANS																																	
8270S	DIBENZOFURAN	0.18	U	0.55	U	0.17	U	0.175	U	0.17	U	0.55	U	0.185	U	0.17	U	1.7	U	0.175	U	0.5	U	5.5	U	0.14	J	0.175	U	0.17	U	0.175	U
8270S	DCDD	NA		1.1	U	NA		NA		NA		1.05	U	NA		NA		NA		NA		1.05	U	10.5	U	1.05	U	NA		NA		NA	
8270S	DCDF	NA		1.1	U	NA		NA		NA		1.05	U	NA		NA		NA		NA		1.6	J	2	J	1.05	U	NA		NA		NA	
8270S	TRCDF	NA		1.1	U	NA		NA		NA		0.83	J	NA		NA		NA		NA		35		150		270		NA		0	U	NA	
SOWZS	TCDF	NA		R		NA		NA		NA		R		NA		NA		NA		NA		R		R		R		NA		0.0000165	U	NA	

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
D - Diluted sample.
F - Estimated maximum concentration.

TABLE 4-23
CRANSTON SITE
PRODUCTION AREA
DEEP SOIL
ORGANIC DATA

	AREA/SUB AREA	SWMU7/B7C	SWMU7/B7F3	SWMU8/B8C	SWMU8/B8D3	SWMU8/B8E3	SWMU8/B8F3	SWMU8/B8F3	SWMU11/B11C	SWMU2/B2B	SWMU2/B2B	SWMU2/B2C	SWMU2/B2D	SWMU2/B2F4	SWMU3/B3A	SWMU3/B3A	SWMU3/B3B
	SAMPLE ID	B-7C*IB-2	B-7F3*II-1	B-8C*IB-2	B-8D3*II-1	B-8E3*II-1	B-8F3*II-1	B-DUP3*II-1	B-11C*IB-2	B-2B*IB-1	B-2B*IB-2	B-2C*IB-2	B-2D*IB-2	B-2F4*II-1	B-3A*IB-1	B-3A*IB-2	B-3B*IB-1
	SAMPLE DATE	3/18/91	7/23/93	3/14/91	7/24/93	7/24/93	7/24/93	1/0/00	3/15/91	12/6/90	3/14/91	3/14/91	3/15/91	7/9/93	11/20/90	3/18/91	11/19/90
	DEPTH RANGE (ft)	4 to 6	4 to 6	4 to 6	4 to 6	4 to 6	4 to 6	4 to 6	5 to 7	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
VOLATILE ORGANICS																	
	HALOGENATED																
8240S	CHLOROBENZENE	0.055 U	0.00275 U	0.06 U	0.0027 U	0.00265 U	0.375 U	0.36 U	0.15 J	0.055 U	0.055 U	0.05 U	0.055 U	NA	2.85 U	0.055 U	0.055 U
8240S	METHYLENE CHLORIDE	0.155 U	0.01	0.155 U	0.0087 J	0.0096	0.375 U	0.36 U	0.265 U	0.125 U	0.26 U	0.185 U	0.055 U	NA	5.5 U	2 U	0.18 U
	AROMATICS																
8240S	ETHYLBENZENE	0.067 J	0.00275 U	0.062 J	0.0027 U	0.00265 U	1.6 J	5.5 J	2.1	0.055 U	0.055 U	0.05 U	0.055 U	NA	5.9	0.94	5.6
8240S	M&P-XYLENE	0.055 U	0.00275 U	0.18	0.0027 U	0.00265 U	7.7 J	30 J	9.2	0.029 J	0.055 U	0.05 U	0.055 U	NA	33	8.1	24
8240S	O-XYLENE	0.028 J	0.00275 U	0.053 J	0.0027 U	0.00265 U	2.4 J	11 J	2.7	0.0087 J	0.055 U	0.05 U	0.055 U	NA	9.4	1.9	5.8
8240S	STYRENE	0.055 U	0.00275 U	0.06 U	0.0027 U	0.00265 U	0.375 U	0.36 U	0.265 U	0.055 U	0.055 U	0.05 U	0.055 U	NA	2.85 U	0.055 U	0.055 U
8240S	TOLUENE	0.034 J	0.00275 U	0.042 J	0.0027 U	0.00265 U	0.375 U	0.36 U	14 J	0.105 U	0.016 J	0.05 U	0.6 U	NA	2.85 U	0.055 U	0.055 U
	KETONE/ALDEHYDES																
8240S	2-BUTANONE	0.3 J	0.0135 U	0.115 U	0.0135 U	0.013 U	1.9 U	1.8 U	0.55 U	0.13 J	0.105 U	0.105 U	0.105 U	NA	5.5 U	0.115 U	0.13 J
8240S	ACETONE	0.11 U	0.0135 U	0.115 U	0.053 J	0.013 U	1.9 U	1.8 U	0.55 U	0.115 U	0.105 U	0.105 U	0.105 U	NA	5.5 U	0.115 U	0.105 U
	OTHER VOLATILE ORGANICS																
8240S	N-OCTANE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
824DS	1,4-DIOXANE	5.5 U	NA	6 U	NA	NA	NA	NA	5.5 U	5.5 U	5.5 U	5.5 U	5.5 U	NA	5 U	4 J	5 U
SEMI-VOLATILE ORGANICS																	
	BASE NEUTRALS																
	PAHs																
8270S	ACENAPHTHENE	0.55 U	0.18 U	0.6 U	0.18 U	0.175 U	0.2 U	0.19 U	0.28 J	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	ANTHRACENE	0.55 U	0.18 U	0.18 J	0.072 J	0.175 U	0.2 U	0.19 U	0.65 J	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	BENZO(A)ANTHRACENE	0.55 U	1.2 J	0.62 J	0.2 J	0.12 U	0.36 J	0.32 J	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.125 U	0.55 U	0.55 U	0.5 U
8270S	BENZO(A)PYRENE	0.55 U	1 J	0.61 J	0.17 J	0.12 U	0.65 J	0.61 J	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.125 U	0.55 U	0.55 U	0.5 U
8270S	BENZO(B)FLUORANTHENE	0.55 U	2.1 J	0.93 J	0.25 J	0.12 U	0.89 J	0.81 J	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.125 U	0.55 U	0.55 U	0.12 J
8270S	BENZO(G,H,I)PERYLENE	0.55 U	0.74 J	0.54 J	0.18 U	0.175 U	0.41 J	0.31 J	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	BENZO(K)FLUORANTHENE	0.55 U	0.64 J	1.2	0.085 J	0.12 U	0.35 J	0.33 J	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.125 U	0.55 U	0.55 U	0.16 J
8270S	CHRYSENE	0.55 U	0.89 J	0.66 J	0.22 J	0.175 U	0.62 J	0.56 J	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	DIBENZ(A,H)ANTHRACENE	0.55 U	0.11 U	0.22 J	0.11 U	0.105 U	0.12 U	0.115 U	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.11 U	0.55 U	0.55 U	0.5 U
8270S	FLUORANTHENE	0.48 J	0.84	1 J	0.42	0.175 U	0.76	0.7	0.24 J	0.15 J	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.085 J
8270S	FLUORENE	0.55 U	0.18 U	0.6 U	0.18 U	0.175 U	0.047 J	0.049 J	0.16 J	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	INDENO(1,2,3-CD)PYRENE	0.55 U	0.67 J	0.43 J	0.11 U	0.105 U	0.42 J	0.32 J	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.11 U	0.55 U	0.55 U	0.5 U
8270S	2-METHYLNAPHTHALENE	0.55 U	0.18 U	0.6 U	0.18 U	0.175 U	0.2 U	0.19 U	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	NAPHTHALENE	0.17 J	0.17 J	0.6 U	0.18 U	0.175 U	0.059 J	0.073 J	0.5 U	0.18 J	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.081 J
8270S	PHENANTHRENE	0.19 J	0.18 U	0.72 J	0.3 J	0.175 U	0.4 J	0.39	0.54 J	0.11 J	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	PYRENE	0.66 J	2.2 J	1 J	0.59 J	0.175 U	1.2 J	1.3 J	0.28 J	0.16 J	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.083 J
	PHTHALATES																
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	0.55 U	0.18 U	0.6 U	0.24 J	0.054 J	0.21 J	0.29 J	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.19 J	0.55 U	0.55 U	0.5 U
8270S	BUTYLBENZYLPHTHALATE	0.55 U	0.18 U	0.6 U	0.18 U	0.175 U	0.072 J	0.14 J	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	DI-N-BUTYLPHTHALATE	0.55 U	0.18 U	0.6 U	0.048 J	0.175 U	0.061 J	0.07 J	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	DIETHYLPHTHALATE	0.55 U	0.18 U	0.6 U	0.18 U	0.175 U	0.2 U	0.19 U	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
	HALOGENATED																
8270S	3,3'-DICHLOROBENZIDINE	1.1 U	0.36 U	1.2 U	0.36 U	0.345 U	0.4 U	0.38 U	1.05 U	1.1 U	1.05 U	1.05 U	1 U	0.355 U	1.15 U	1.15 U	1.05 U
8270S	1,2-DICHLOROBENZENE	0.55 U	0.18 U	0.6 U	0.18 U	0.175 U	0.2 U	0.19 U	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	BIS(2-CHLOROETHYL)ETHER	0.55 U	0.18 U	0.6 U	0.18 U	0.175 U	0.2 U	0.05 J	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	1,2,4-TRICHLOROBENZENE	0.55 U	0.18 U	0.6 U	0.18 U	0.175 U	0.2 U	0.19 U	0.49 J	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
	OTHER BASE NEUTRALS																
8270S	2-NITROANILINE	2.7 U	4.2	2.95 U	0.9 U	0.9 U	1 U	1 U	2.6 U	2.75 U	2.65 U	2.65 U	2.55 U	0.9 U	2.85 U	2.85 U	2.6 U
8270S	4-CHLOROANILINE	0.55 U	0.36 U	0.6 U	0.36 U	0.345 U	0.4 U	0.38 U	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.355 U	0.55 U	0.55 U	0.5 U
8270S	ANILINE	0.55 U	0.22 J	0.6 U	0.18 U	0.175 U	0.22 J	0.28 J	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	NITROBENZENE	0.55 U	2.1	0.6 U	0.18 U	0.175 U	0.2 U	0.19 U	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	P-PHENYLENEDIAMINE	2.7 U	0.95 U	2.95 U	0.9 U	0.9 U	1 U	1 U	15	2.75 U	2.65 U	2.65 U	2.55 U	0.9 U	2.85 U	2.85 U	2.6 U
8270S	ACETOPHENONE	0.55 U	0.18 U	0.6 U	0.18 U	0.175 U	0.52	0.66	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
	ACID EXTRACTABLES																
	PHENOLS																
8270S	2,4-DICHLOROPHENOL	0.55 U	0.18 U	0.6 U	0.18 U	0.175 U	0.2 U	0.19 U	2.6	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	2,4-DIMETHYLPHENOL	0.55 U	0.18 U	0.6 U	0.18 U	0.175 U	1.3	1.7	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.18 J	0.55 U	0.26 J
8270S	2-METHYLPHENOL	0.55 U	0.18 U	0.6 U	0.18 U	0.175 U	0.2 U	0.084 J	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	2-NITROPHENOL	0.55 U	0.075 J	0.6 U	0.18 U	0.175 U	0.2 U	0.19 U	0.5 U	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	4-METHYLPHENOL	0.55 U	NA	0.6 U	NA	NA	NA	NA	0.13 J	0.55 U	0.55 U	0.55 U	3.4	NA	0.55 U	0.55 U	0.5 U
8270S	PHENOL	0.24 J	0.18 U	0.6 U	0.18 U	0.175 U	0.2 U	0.19 U	0.15 J	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	2,6-DICHLOROPHENOL	0.55 U	0.18 U	0.6 U	0.18 U	0.175 U	0.2 U	0.19 U	2.8	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	3&4-METHYLPHENOL	NA	0.18 U	NA	0.18 U	0.175 U	0.12 J	0.17 J	NA	NA	NA	NA	NA	0.175 U	NA	NA	NA
FINGERPRINT COMPOUNDS																	
8270S	IRGASAN DP-300	2.7 U	NA	2.95 U	NA	NA	0.2 U	0.19 U	390 J	2.75 U	2.65 U	0 R	2.55 U	NA	2.85 U	2.85 U	2.6 U
8270S	TINUVIN 327	2.7 U	NA	2.95 U	NA	NA	NA	NA	2.6 U	2.75 U	2.65 U	0 R	2.55 U	NA	0.49 J	2.85 U	2.6 U
8270S	TINUVIN 328	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCBs																	
8080S	PCB-1254	0.51	0.36 U	3.5 J	0.058	0.0175 U	0.11	0.1	0.5 U	0.85 J	0.21	0.78	0.19 J	0.054	0.11 U	4.3	3.8
8080S	PCB-1260	0.011 U	0.36 U	0.115 U	0.018 U	0.0175 U	0.02 U	0.019 U	0.5 U	0.0115 U	0.011 U	0.05 U	0.0105 U	0.0175 U	3.3	0.11 U	0.105 U
ORGANOCHLORINE PESTICIDES																	
8080S	4,4'-DDD	0.00055 U	0.036 U	0.006 U	0.0018 U	0.00175 U	0.002 U	0.0019 U	0.23 J	0.00055 U	0.00055 U	0.0026 U	0.00055 U	0.00175 U	0.0055 U	0.0055 U	0.0055 U
8080S	4,4'-DDE	0.00055 U	0.036 U	0.006 U	0.0018 U	0.00175 U	0.002 U	0.0019 U	0.0255 U	0.00055 U	0.00055 U	0.0026 U	0.00055 U	0.00175 U	0.0055 U	0.0055 U	0.0055 U
8080S	4,4'-DDT	0.0011 U	0.084 J	0.0115 U	0.0018 U	0.00175 U	0.002 U	0.0019 U	0.05 U	0.00115 U	0.0011 U	0.005 U	0.00105 U	0.00175 U	0.011 U	0.011 U	0.0105 U
8080S	ALDRIN	0.00055 U	0.0185 U	0.006 U	0.0009 U	0.0009 U	0.001 U	0.001 U	0.0255 U	0.00055 U	0.00055 U	0.0026 U	0.00055 U	0.0009 U	0.0055 U	0.0055 U	0.0055 U
8080S	ALPHA-BHC	0.00055 U	0.0185 U	0.018 J	0.0009 U	0.0009 U	0.001 U	0.001 U	0.0255 U	0.00055 U	0.00055 U	0.0026 U	0.00055 U	0.0009 U	0.0055 U	0.0055 U	0.0055 U
8080S	ALPHA-CHLORDANE	0.00055 U	0.0185 U	0.006 U	0.0009 U	0.0009 U	0.001 U	0.001 U	0.0255 U	0.00055 U	0.00055 U	0.0026 U	0.00055 U	0.0009 U	0.0055 U	0.0055 U	0.0055 U
8080S	BETA-BHC	0.00055 U	0.0185 U	0.1 J	0.0009 U	0.0009 U	0.001 U	0.001 U	0.0255 U	0.00055 U	0.00055 U	0.0026 U	0.00055 U	0.0009 U	0.0055 U	0.0055 U	0.0055 U
8080S	CHLOROBENZILATE	NA	0.185 U	NA	0.009 U	0.009 U	0.01 U	0.01 U	NA	NA	NA	NA	NA	0.009 U	NA	NA	NA
8080S	DELTA-BHC	0.00055 U	0.0185 U	0.006 U	0.0009 U	0.0009 U	0.001 U	0.001 U	0.086 J	0.00055 U	0.00055 U	0.0026 U	0.00055 U	0.0009 U	0.0055 U	0.0055 U	0.0055 U
8080S	ENDOSULFAN SULFATE	0.00275 U	0.096 J	0.029 U	0.0018 U	0.00175 U	0.002 U	0.0019 U	0.13 U	0.0028 U	0.0027 U	0.013 U	0.00265 U	0.00175 U	0.0275 U	0.028 U	0.0265 U
8080S	ENDRIN ALDEHYDE	0.0011 U	0.036 U	0.0115 U	0.0018 U	0.00175 U	0.002 U	0.0019 U	0.05 U	0.00115 U	0.0011 U	0.005 U	0.00105 U	0.00175 U	0.011 U	0.011 U	0.0105 U
8080S	GAMMA-BHC	0.006	0.0185 U	0.036	0.0009 U	0.0009 U	0.001 U	0.001 U	0.0255 U	0.00055 U	0.0016	0.0026 U	0.0026 J	0.0009 U	0.0055 U	0.0055 U	0.015
8080S	GAMMA-CHLORDANE	0.00055 U	0.0185 U	0.006 U	0.0009 U	0.0009 U	0.001 U	0.001 U	0.0255 U	0.00055 U	0.00055 U	0.0026 U	0.00055 U	0.0009 U	0.0055 U	0.0055 U	0.0055 U
8080S	HEPTACHLOR	0.008	0.0185 U	0.006 U	0.0009 U	0.0009 U	0.001 U	0.001 U	0.0255 U	0.00055 U	0.00055 U	0.0026 U	0.00055 U	0.0009 U	0.0055 U	0.0037 J	0.0055 U
8080S	HEPTACHLOR EPOXIDE	0.00055 U	0.0185 U	0.006 U	0.0009 U	0.0009 U	0.001 U	0.001 U	0.0255 U	0.00055 U	0.00055 U	0.0026 U	0.00055 U	0.0009 U	0.0055 U	0.0055 U	0.0055 U
8080S	ISODRIN	0.00055 U	0.036 U	0.006 U	0.0018 U	0.0018 U	0.002 U	0.0019 U	0.0255 U	0.00055 U	0.00055 U	0.0026 U	0.00055 U	0.00175 U	0.0055 U	0.0055 U	0.0055 U
8080S	METHOXYCHLOR	0.00275 U	0.185 U	0.029 U	0.009 U	0.009 U	0.01 U	0.01 U	0.13 U	0.0028 U	0.0027 U	0.013 U	0.00265 U	0.009 U	0.0275 U	0.028 U	0.0265 U
ORGANOPHOSPHORUS PESTICIDES																	
8142S	DISULFOTON	0.055 U	0.07 U	0.06 U	0.07 U	0.07 U	0.08 U	0.075 U	0.055 U	0.055 U	0.055 U	0.05 U	0.055 U	0.07 U	0.0095 J	0.055 U	0.055 U
8142S	ETHYL PARATHION	0.0415 U	0.018 U	0.0435 U	0.018 U	0.0175 U	0.02 U	0.019 U	0.013 J	0.0425 U	0.0405 U	0.0385 U	0.0395 U	0.0175 U	0.0425 U	0.0425 U	0.04 U
8142S	METHYL PARATHION	0.0085 U	0.0095 U	0.0085 U	0.009 U	0.009 U	0.01 U	0.01 U	0.008 U	0.0058 J	0.008 U	0.0075 U	0.008 U	0.009 U	0.0085 U	0.0085 U	0.0058 J
HERBICIDES																	
8151S	2,4,5-T	0.011 U	NA	0.017 J	NA	NA	0.01 U	0.01 U	0.01 U	0.0115 U	0.0105 U	0.0105 U	0.0058 J	NA	0.0105 U	0.0115 U	0.01 U
8151S	2,4,5-TP (SILVEX)	0.0095 U	NA	0.0095 U	NA	NA	0.01 U	0.01 U	0.0085 U	0.0095 U	0.009 U	0.0085 U	0.009 U	NA	0.009 U	0.0095 U	0.0085 U
8151S	2,4-D	0.065 U	NA	0.028 J	NA	NA	0.046 J	0.11 J	0.06 U	0.07 U	0.065 U	0.06 U	0.065 U	NA	0.065 U	0.07 U	0.06 U
8151S	DINOSEB	0.0085 U	NA	0.0085 U	NA	NA	NA	NA	0.0075 U	0.0085 U	0.008 U	0.0075 U	0.008 U	NA	0.008 U	0.0085 U	0.0075 U
CHLORINATED DIOXINS AND FURANS																	
8270S	DIBENZOFURAN	0.55 U	0.18 U	0.6 U	0.18 U	0.175 U	0.2 U	0.19 U	0.4 J	0.55 U	0.55 U	0.55 U	0.5 U	0.175 U	0.55 U	0.55 U	0.5 U
8270S	DCDD	1.1 U	NA	1.2 U	NA	NA	NA	NA	0.6 J	1.1 U	1.05 U	1.05 U	1 U	NA	1.15 U	1.15 U	1.05 U
8270S	DCDF	1.1 U	NA	1.2 U	NA	NA	NA	NA	15	1.1 U	1.05 U	1.05 U	1 U	NA	1.15 U	1.15 U	1.05 U
8270S	TRCDF	1.1 U	NA	1.2 U	NA	NA	0 U	0 U	84	0.36 J	1.05 U	1.05 U	1 U	NA	0.81 J	1.15 U	0.53 J
SOWZS	TCDF	R	NA	R	NA	NA	0.00007 U	NA	R	R	R	R	R	NA	R	R	R

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
D - Diluted sample.
F - Estimated maximum concentration.

TABLE 4-23
CRANSTON SITE
PRODUCTION AREA
DEEP SOIL
ORGANIC DATA

	AREA/SUB AREA	SWMU3/B3D	SWMU3/B3E4	SWMU3/B3F4	SWMU3/B3H4	SWMU7/B7D4	SWMU7/B7E4	SWMU7/B7G4	SWMU7/B7H4	SWMU2/B2A	AOC13/B13A3	AOC13/B13A4	SWMUs & AOC13 SUMMARY				
	SAMPLE ID	B-3D*IB-2	B-3B4*II-1	B-3F4*II-1	B-3H4*II-1	B-7D4*II-1	B-7E4*II-1	B-7G4*II-1	B-7H4*II-1	B-2A*IB-1	B-13A3*II-1	B-13A4*II-1					
	SAMPLE DATE	3/18/91	7/12/93	7/12/93	7/12/93	7/23/93	7/23/93	7/23/93	7/23/93	11/19/90	7/20/93	7/20/93					
	DEPTH RANGE (ft)	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	6 to 8	8 to 10	4 to 6	6 to 8					
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
VOLATILE ORGANICS																	
	HALOGENATED																
8240S	CHLOROBENZENE	0.055 U	0.345 U	0.00265 U	0.33 U	0.0135 U	0.013 U	0.018	0.0026 U	0.06 U	0.0027 U	0.0026 U	2	0.084	1.13	0.15	0.018
8240S	METHYLENE CHLORIDE	0.39 U	0.345 U	0.0071	1.5	0.023 U	0.0215 U	0.011	0.009	0.275 U	0.0067	0.0026 U	14	0.115	1.31	1.5	0.006
	AROMATICS																
8240S	ETHYLBENZENE	0.03 J	0.345 U	0.00265 U	0.33 U	0.0135 U	0.013 U	0.0027 U	0.0026 U	0.06 U	0.0027 U	0.0026 U	14	5.92	2.1	29	0.018
8240S	M&P-XYLENE	0.055 U	3.8 J	0.011 J	1.4 J	0.031	2	0.0027 U	0.0026 U	0.06 U	0.0027 U	0.0026 U	21	16.8	8.8	120	0.0056
8240S	O-XYLENE	0.02 J	0.86 J	0.00265 U	0.33 U	0.0135 U	0.44	0.0027 U	0.0026 U	0.06 U	0.0027 U	0.0026 U	18	4.82	2.18	27	0.0087
8240S	STYRENE	0.014 J	0.345 U	0.0075	0.33 U	0.0135 U	0.013 U	0.0027 U	0.0026 U	0.06 U	0.0027 U	0.0026 U	3	0.0168	1.13	0.029	0.0075
8240S	TOLUENE	0.085 J	0.345 U	0.00265 U	0.33 U	0.0135 U	0.013 U	0.0027 U	0.0026 U	0.079 J	0.0027 U	0.0026 U	13	188	61.3	1200	0.0056
	KETONE/ALDEHYDES																
8240S	2-BUTANONE	0.29 J	1.75 U	0.013 U	1.65 U	0.065 U	0.065 U	0.0135 U	0.013 U	0.125 U	0.0135 U	0.013 U	4	0.213	2.42	0.3	0.13
8240S	ACETONE	0.11 U	1.75 U	0.013 U	1.65 U	0.065 U	0.065 U	0.0135 U	0.013 U	0.125 U	0.0135 U	0.013 U	1	0.053	2.41	0.053	0.053
	OTHER VOLATILE ORGANICS																
8240S	N-OCTANE	NA	NA	NA	12 J	NA	4.3	NA	NA	NA	NA	NA	2	8.15	8.15	12	4.3
824DS	1,4-DIOXANE	5.5 U	NA	NA	NA	NA	NA	NA	NA	5 U	NA	NA	1	4	5.29	4	4
SEMI-VOLATILE ORGANICS																	
	BASE NEUTRALS																
	PAHs																
8270S	ACENAPHTHENE	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	2	0.165	0.463	0.28	0.049
8270S	ANTHRACENE	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.042 J	0.17 U	0.6 U	0.175 U	0.17 U	8	0.184	0.448	0.65	0.042
8270S	BENZO(A)ANTHRACENE	0.55 U	0.13 U	0.12 U	0.12 U	0.12 U	0.12 U	0.14 J	0.12 U	0.6 U	0.125 U	0.12 U	13	0.398	0.466	1.2	0.14
8270S	BENZO(A)PYRENE	0.55 U	0.13 U	0.12 U	0.12 U	0.12 U	0.12 U	0.15 J	0.12 U	0.6 U	0.15 J	0.055 J	17	0.323	0.471	1	0.024
8270S	BENZO(B)FLUORANTHENE	0.66 J	0.04 J	0.12 U	0.12 U	0.12 U	0.12 U	0.19 J	0.12 U	0.6 U	0.2 J	0.076 J	22	0.437	0.525	2.1	0.028
8270S	BENZO(G,H,I)PERYLENE	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.086 J	0.17 U	9	0.32	0.49	0.74	0.086
8270S	BENZO(K)FLUORANTHENE	0.8 J	0.13 U	0.12 U	0.12 U	0.12 U	0.12 U	0.072 J	0.12 U	0.6 U	0.098 J	0.036 J	15	0.327	0.46	1.2	0.036
8270S	CHRYSENE	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.16 J	0.17 U	0.6 U	0.14 J	0.052 J	15	0.394	0.494	0.89	0.052
8270S	DIBENZ(A,H)ANTHRACENE	0.55 U	0.11 U	0.105 U	0.105 U	0.105 U	0.105 U	0.11 U	0.105 U	0.6 U	0.11 U	0.105 U	2	0.143	0.406	0.22	0.066
8270S	FLUORANTHENE	0.52 J	0.056 J	0.175 U	0.175 U	0.175 U	0.17 U	0.37	0.17 U	0.6 U	0.23 J	0.077 J	27	0.462	0.407	1.2	0.043
8270S	FLUORENE	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	5	0.0742	0.451	0.16	0.047
8270S	INDENO(1,2,3-CD)PYRENE	0.55 U	0.11 U	0.105 U	0.105 U	0.105 U	0.105 U	0.1 J	0.105 U	0.6 U	0.089 J	0.105 U	10	0.281	0.444	0.67	0.089
8270S	2-METHYLNAPHTHALENE	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	1	0.081	0.469	0.081	0.081
8270S	NAPHTHALENE	0.22 J	0.088 J	0.175 U	0.175 U	0.059 J	0.065 J	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	15	0.152	0.28	0.68	0.029
8270S	PHENANTHRENE	0.19 J	0.03 J	0.175 U	0.175 U	0.175 U	0.17 U	0.16 J	0.17 U	0.6 U	0.061 J	0.17 U	21	0.334	0.321	1	0.03
8270S	PYRENE	0.67 J	0.048 J	0.175 U	0.175 U	0.175 U	0.17 U	0.38	0.17 U	0.6 U	0.28 J	0.1 J	26	0.582	0.597	2.2	0.042
	PHTHALATES																
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	0.55 U	1.2	0.26 J	0.51	0.175 U	0.17 U	0.2 U	0.19 U	0.6 U	0.6	0.57	20	0.495	0.618	2.2	0.054
8270S	BUTYLBENZYLPHTHALATE	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	5	0.151	0.459	0.37	0.044
8270S	DI-N-BUTYLPHTHALATE	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	6	0.053	0.445	0.07	0.042
8270S	DIETHYLPHTHALATE	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	1	0.67	0.359	0.67	0.67
	HALOGENATED																
8270S	3,3'-DICHLOROBENZIDINE	1.1 U	0.365 U	0.35 U	0.345 U	0.35 U	0.345 U	0.36 U	0.345 U	1.25 U	0.355 U	0.345 U	1	0.73	0.946	0.73	0.73
8270S	1,2-DICHLOROBENZENE	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	1	0.76	0.477	0.76	0.76
8270S	BIS(2-CHLOROETHYL)ETHER	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	1	0.05	0.468	0.05	0.05
8270S	1,2,4-TRICHLOROBENZENE	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	3	0.44	0.467	0.64	0.19
	OTHER BASE NEUTRALS																
8270S	2-NITROANILINE	2.7 U	0.95 U	0.9 U	0.9 U	0.9 U	0.9 U	0.9 U	0.9 U	3.1 U	0.9 U	0.9 U	1	4.2	2.44	4.2	4.2
8270S	4-CHLOROANILINE	0.55 U	0.365 U	0.35 U	0.345 U	0.35 U	0.345 U	0.36 U	0.345 U	0.6 U	0.355 U	0.345 U	3	0.167	0.53	0.36	0.042
8270S	ANILINE	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	4	0.233	0.475	0.28	0.21
8270S	NITROBENZENE	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	2	1.19	0.511	2.1	0.28
8270S	P-PHENYLENEDIAMINE	2.7 U	0.95 U	0.9 U	0.9 U	0.9 U	0.9 U	0.9 U	0.9 U	3.1 U	0.9 U	0.9 U	1	15	2.66	15	15
8270S	ACETOPHENONE	0.55 U	0.075 J	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	3	0.418	0.487	0.66	0.075
	ACID EXTRACTABLES																
	PHENOLS																
8270S	2,4-DICHLOROPHENOL	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	4	4	0.681	6.2	2.6
8270S	2,4-DIMETHYLPHENOL	0.55 U	0.08 J	0.175 U	0.175 U	0.095 J	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	6	0.603	0.514	1.7	0.08
8270S	2-METHYLPHENOL	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	1	0.084	0.469	0.084	0.084
8270S	2-NITROPHENOL	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	1	0.075	0.469	0.075	0.075
8270S	4-METHYLPHENOL	0.55 U	NA	NA	NA	NA	NA	NA	NA	0.6 U	NA	NA	3	1.21	0.955	3.4	0.1
8270S	PHENOL	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	3	0.31	0.457	0.54	0.15
8270S	2,6-DICHLOROPHENOL	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	1	2.8	0.525	2.8	2.8
8270S	3&4-METHYLPHENOL	NA	1	0.13 J	0.53	0.175 U	0.17 U	0.033 J	0.05 J	NA	0.175 U	0.17 U	12	0.419	0.346	1.2	0.026
FINGERPRINT COMPOUNDS																	
8270S	IRGASAN DP-300	2.7 U	NA	NA	NA	NA	NA	NA	NA	3.1 U	NA	NA	5	160	43.8	390	0
8270S	TINUVIN 327	2.7 U	NA	NA	NA	NA	NA	NA	NA	3.1 U	NA	NA	2	0.245	3.83	0.49	0
8270S	TINUVIN 328	NA	NA	NA	2.4	NA	12	NA	NA	NA	NA	NA	2	7.2	7.2	12	2.4
PCBs																	
8080S	PCB-1254	3.4	0.95	0.054	0.54	0.92	0.085 U	0.27 J	0.36	0.0125 U	0.34	0.074	33	1.28	1.06	9	0.054
8080S	PCB-1260	0.11 U	2.6	0.07	0.64	1.9	2.6	0.018 U	0.017 U	0.0125 U	0.0175 U	0.017 U	8	3.24	0.689	13	0.07
ORGANOCHLORINE PESTICIDES																	
8080S	4,4'-DDD	0.0055 U	0.009 U	0.00175 U	0.00175 U	0.009 U	0.0085 U	0.0018 U	0.0017 U	0.00065 U	0.00175 U	0.0017 U	1	0.23	0.0122	0.23	0.23
8080S	4,4'-DDE	0.0055 U	0.009 U	0.00175 U	0.00175 U	0.009 U	0.0085 U	0.0018 U	0.0017 U	0.00065 U	0.00175 U	0.0017 U	1	0.71	0.0227	0.71	0.71
8080S	4,4'-DDT	0.011 U	0.009 U	0.00175 U	0.00175 U	0.009 U	0.0085 U	0.0018 U	0.0017 U	0.00125 U	0.00175 U	0.0017 U	2	0.217	0.0188	0.35	0.084
8080S	ALDRIN	0.0055 U	0.0047 U	0.0009 U	0.0009 U	0.0045 U	0.0044 U	0.0009 U	0.0009 U	0.00065 U	0.0009 U	0.0009 U	1	0.44	0.0151	0.44	0.44
8080S	ALPHA-BHC	0.0055 U	0.0047 U	0.0009 U	0.0009 U	0.0045 U	0.0044 U	0.0009 U	0.0009 U	0.0013	0.0009 U	0.0009 U	3	0.0124	0.0066	0.018	0.0013
8080S	ALPHA-CHLORDANE	0.0055 U	0.0047 U	0.0009 U	0.0009 U	0.0045 U	0.0044 U	0.0009 U	0.0009 U	0.00065 U	0.0009 U	0.0009 U	0		0.00601		
8080S	BETA-BHC	0.0055 U	0.0047 U	0.0009 U	0.0009 U	0.0045 U	0.0044 U	0.0009 U	0.0009 U	0.00065 U	0.0009 U	0.0009 U	1	0.1	0.0082	0.1	0.1
8080S	CHLOROBENZILATE	NA	0.047 U	0.009 U	0.009 U	0.045 U	0.044 U	0.009 U	0.098 J	NA	0.009 U	0.009 U	1	0.098	0.0277	0.098	0.098
8080S	DELTA-BHC	0.0055 U	0.0047 U	0.0009 U	0.0009 U	0.0045 U	0.0044 U	0.0009 U	0.0009 U	0.00065 U	0.0009 U	0.0009 U	1	0.086	0.0084	0.086	0.086
8080S	ENDOSULFAN SULFATE	0.0275 U	0.009 U	0.00175 U	0.00175 U	0.009 U	0.0085 U	0.0018 U	0.0017 U	0.00315 U	0.00175 U	0.0017 U	1	0.096	0.0272	0.096	0.096
8080S	ENDRIN ALDEHYDE	0.011 U	0.009 U	0.00175 U	0.00175 U	0.009 U	0.0085 U	0.0018 U	0.0017 U	0.0018 J	0.00175 U	0.0017 U	1	0.0018	0.012	0.0018	0.0018
8080S	GAMMA-BHC	0.02	0.0047 U	0.0009 U	0.0009 U	0.0045 U	0.0044 U	0.0009 U	0.0009 U	0.0019	0.0009 U	0.0009 U	7	0.0119	0.0075	0.036	0.0016
8080S	GAMMA-CHLORDANE	0.0055 U	0.0047 U	0.0009 U	0.0009 U	0.0045 U	0.0044 U	0.013	0.0096 J	0.0021	0.0009 U	0.0009 U	6	0.0132	0.00757	0.028	0.0021
8080S	HEPTACHLOR	0.0055 U	0.0047 U	0.0009 U	0.0009 U	0.0045 U	0.0044 U	0.0009 U	0.0009 U	0.00065 U	0.0009 U	0.0009 U	3	0.0179	0.00652	0.042	0.0037
8080S	HEPTACHLOR EPOXIDE	0.0055 U	0.0047 U	0.0009 U	0.0009 U	0.0045 U	0.0044 U	0.0009 U	0.0009 U	0.00065 U	0.0009 U	0.0009 U	0		0.00601		
8080S	ISODRIN	0.0055 U	0.009 U	0.00175 U	0.00175 U	0.009 U	0.0085 U	0.0018 U	0.01	0.00065 U	0.00175 U	0.0017 U	2	0.115	0.0115	0.22	0.01
8080S	METHOXYCHLOR	0.0275 U	0.047 U	0.009 U	0.009 U	0.045 U	0.044 U	0.009 U	0.009 U	0.00315 U	0.092	0.009 U	5	0.131	0.0617	0.44	0.032
ORGANOPHOSPHORUS PESTICIDES																	
8142S	DISULFOTON	0.055 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.065 U	0.07 U	0.07 U	2	0.00475	0.0618	0.0095	0.0095
8142S	ETHYL PARATHION	0.041 U	0.0185 U	0.0175 U	0.0175 U	0.0175 U	0.017 U	0.018 U	0.017 U	0.0475 U	0.0175 U	0.017 U	2	0.0065	0.0254	0.013	0.013
8142S	METHYL PARATHION	0.008 U	0.0095 U	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U	0.0067 J	0.009 U	0.009 U	5	0.00506	0.00838	0.007	0.006
HERBICIDES																	
8152S	2,4,5-T	0.011 U	NA	NA	NA	NA	NA	NA	NA	0.0125 U	NA	NA	2	0.0114	0.0106	0.017	0.0058
8152S	2,4,5-TP (SILVEX)	0.0095 U	NA	NA	NA	NA	NA	NA	NA	0.0105 U	NA	NA	1	0.0072	0.00911	0.0072	0.0072
8152S	2,4-D	0.065 U	NA	NA	NA	NA	NA	NA	NA	0.075 U	NA	NA	6	0.0409	0.0578	0.11	0.0082
8152S	DINOSEB	0.0055 J	NA	NA	NA	NA	NA	NA	NA	0.009 U	NA	NA	2	0.00545	0.00773	0.0055	0.0054
CHLORINATED DIOXINS AND FURANS																	
8270S	DIBENZOFURAN	0.55 U	0.185 U	0.175 U	0.175 U	0.175 U	0.17 U	0.18 U	0.17 U	0.6 U	0.175 U	0.17 U	2	0.27	0.461	0.4	0.14
8270S	DCDD	1.1 U	NA	NA	NA	NA	NA	NA	NA	1.25 U	NA	NA	1	0.6	1.62	0.6	0.6
8270S	DCDF	1.1 U	NA	NA	NA	NA	NA	NA	NA	1.25 U	NA	NA	3	6.2	2	15	1.6
8270S	TRCDF	1.2 J	NA	NA	0.27 J	NA	0 U	NA	NA	1.25 U	NA	NA	10	54.3	25.1	270	0.27
SOWZS	TCDF	R	NA	NA	0.000056 F	NA	0.000075 U	NA	NA	R	NA	NA	1	0.000056	0.000104	0.000056	0.000056

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
D - Diluted sample.
F - Estimated maximum concentration.

TABLE 4-2
CRANSTON SITE
PRODUCTION AREA
DEEP SOIL
ORGANIC DATA

AREA/SUB AREA	AAOI15/B15A	AAOI15/MW16S	AAOI15/MW16S	AAOI15 SUMMARY				
SAMPLE ID	B-15A*IB-2	SS-MW-16S*IB-1	SS-MW-16S*IB-2					
SAMPLE DATE	3/14/91	12/5/90	3/14/91	Frequency		Average Reported		
DEPTH RANGE (ft)	2 to 4	8 to 10	8 to 10	of	Average	(with 1/2	Maximum	Minimum
	Result Q	Result Q	Result Q	Detection	Detected	detection limit)	Detected	Detected
VOLATILE ORGANICS								
HALOGENATED								
8240S CHLOROBENZENE	0.055 U	0.065 U	0.05 U	0		0.0567		
8240S METHYLENE CHLORIDE	0.14 U	0.065 U	0.17 U	0		0.125		
AROMATICS								
8240S ETHYLBENZENE	0.055 U	0.065 U	0.05 U	0		0.0567		
8240S M&P-XYLENE	0.055 U	0.065 U	0.0082 J	1	0.0082	0.0427	0.008	0.008
8240S O-XYLENE	0.055 U	0.065 U	0.05 U	0		0.0567		
8240S STYRENE	0.055 U	0.065 U	0.05 U	0		0.0567		
8240S TOLUENE	0.016 J	0.065 U	0.014 J	2	0.015	0.0317	0.016	0.014
KETONE/ALDEHYDES								
8240S 2-BUTANONE	0.11 U	0.13 U	0.105 U	0		0.115		
8240S ACETONE	0.11 U	0.13 U	0.105 U	0		0.115		
OTHER VOLATILE ORGANICS								
8240S N-OCTANE	NA	NA	NA	0				
824DS 1,4-DIOXANE	5.5 U	6.5 U	5.5 U	0		5.83		
SEMI-VOLATILE ORGANICS								
BASE NEUTRALS								
PAHs								
8270S ACENAPHTHENE	0.55 U	0.6 U	0.55 U	0		0.567		
8270S ANTHRACENE	0.16 J	0.6 U	0.55 U	1	0.16	0.437	0.160	0.160
8270S BENZO(A)ANTHRACENE	1.2	0.6 U	0.14 J	2	0.67	0.647	1.200	0.140
8270S BENZO(A)PYRENE	1.2	0.6 U	0.11 J	2	0.655	0.637	1.200	0.110
8270S BENZO(B)FLUORANTHENE	2.2	0.6 U	0.22 J	2	1.21	1.01	2.200	0.220
8270S BENZO(G,H,I)PERYLENE	0.98 J	0.6 U	0.55 U	1	0.98	0.71	0.980	0.980
8270S BENZO(K)FLUORANTHENE	2.8	0.6 U	0.29 J	2	1.55	1.23	2.800	0.290
8270S CHRYSENE	1.8	0.6 U	0.18 J	2	0.99	0.86	1.800	0.180
8270S DIBENZ(A,H)ANTHRACENE	0.11 J	0.6 U	0.55 U	1	0.11	0.42	0.110	0.110
8270S FLUORANTHENE	3.2	0.6 U	0.29 J	2	1.75	1.36	3.200	0.290
8270S FLUORENE	0.075 J	0.6 U	0.55 U	1	0.075	0.408	0.075	0.075
8270S INDENO(1,2,3-CD)PYRENE	0.87 J	0.6 U	0.55 U	1	0.87	0.673	0.870	0.870
8270S 2-METHYLNAPHTHALENE	0.55 U	0.6 U	0.55 U	0		0.567		
8270S NAPHTHALENE	0.55 U	0.6 U	0.55 U	0		0.567		
8270S PHENANTHRENE	1.5	0.6 U	0.16 J	2	0.83	0.753	1.500	0.160
8270S PYRENE	2.8	0.6 U	0.27 J	2	1.54	1.22	2.800	0.270
PHTHALATES								
8270S BIS(2-ETHYLHEXYL)PHTHALATE	0.55 U	0.6 U	0.55 U	0		0.567		
8270S BUTYLBENZYLPHTHALATE	0.55 U	0.6 U	0.55 U	0		0.567		
8270S DI-N-BUTYLPHTHALATE	0.55 U	0.6 U	0.55 U	0		0.567		
8270S DIETHYLPHTHALATE	0.55 U	0.6 U	0.55 U	0		0.567		
HALOGENATED								
8270S 3,3'-DICHLOROBENZIDINE	1.1 U	1.25 U	1.05 U	0		1.13		
8270S 1,2-DICHLOROBENZENE	0.55 U	0.6 U	0.55 U	0		0.567		
8270S BIS(2-CHLOROETHYL)ETHER	0.55 U	0.6 U	0.55 U	0		0.567		
8270S 1,2,4-TRICHLOROBENZENE	0.55 U	0.6 U	0.55 U	0		0.567		
OTHER BASE NEUTRALS								
8270S 2-NITROANILINE	2.75 U	3.1 U	2.65 U	0		2.83		
8270S 4-CHLOROANILINE	0.55 U	0.6 U	0.55 U	0		0.567		
8270S ANILINE	0.55 U	0.6 U	0.55 U	0		0.567		
8270S NITROBENZENE	0.55 U	0.6 U	0.55 U	0		0.567		
8270S P-PHENYLENEDIAMINE	2.75 U	3.1 U	2.65 U	0		2.83		
8270S ACETOPHENONE	0.55 U	0.6 U	0.55 U	0		0.567		
ACID EXTRACTABLES								
PHENOLS								
8270S 2,4-DICHLOROPHENOL	0.55 U	0.6 U	0.55 U	0		0.567		
8270S 2,4-DIMETHYLPHENOL	0.55 U	0.6 U	0.55 U	0		0.567		
8270S 2-METHYLPHENOL	0.55 U	0.6 U	0.55 U	0		0.567		
8270S 2-NITROPHENOL	0.55 U	0.6 U	0.55 U	0		0.567		
8270S 4-METHYLPHENOL	0.55 U	0.6 U	0.55 U	0		0.567		
8270S PHENOL	0.55 U	0.6 U	0.55 U	0		0.567		
8270S 2,6-DICHLOROPHENOL	0.55 U	0.6 U	0.55 U	0		0.567		
8270S 3&4-METHYLPHENOL	NA	NA	NA	0				
FINGERPRINT COMPOUNDS								
8270S IRGASAN DP-300	2.75 U	3.1 U	2.65 U	0		2.83		
8270S TINUVIN 327	2.75 U	3.1 U	2.65 U	0		2.83		
8270S TINUVIN 328	NA	NA	NA	0				
PCBs								
8080S PCB-1254	0.011 U	0.0125 U	0.011 U	0		0.0115		
8080S PCB-1260	0.011 U	0.0125 U	0.011 U	0		0.0115		
ORGANOCHLORINE PESTICIDES								
8080S 4,4'-DDD	0.00055 U	0.00065 U	0.00055 U	0		0.000583		
8080S 4,4'-DDE	0.031	0.00065 U	0.00055 U	1	0.031	0.0107	0.031	0.031
8080S 4,4'-DDT	0.057	0.00125 U	0.0011 U	1	0.057	0.0198	0.057	0.057
8080S ALDRIN	0.00055 U	0.00065 U	0.00055 U	0		0.000583		
8080S ALPHA-BHC	0.00055 U	0.00065 U	0.00055 U	0		0.000583		
8080S ALPHA-CHLORDANE	0.00055 U	0.00065 U	0.0083	1	0.0083	0.00317	0.008	0.008
8080S BETA-BHC	0.00055 U	0.00065 U	0.00055 U	0		0.000583		
8080S CHLOROBENZILATE	NA	NA	NA	0				
8080S DELTA-BHC	0.00055 U	0.00065 U	0.0047	1	0.0047	0.00197	0.005	0.005
8080S ENDOSULFAN SULFATE	0.00275 U	0.0032 U	0.0027 U	0		0.00288		
8080S ENDRIN ALDEHYDE	0.0011 U	0.00125 U	0.0025	1	0.0025	0.00162	0.003	0.003
8080S GAMMA-BHC	0.00055 U	0.00065 U	0.0015	1	0.0015	0.0009	0.002	0.002
8080S GAMMA-CHLORDANE	0.00055 U	0.00065 U	0.00055 U	0		0.000583		
8080S HEPTACHLOR	0.00055 U	0.00065 U	0.00055 U	0		0.000583		
8080S HEPTACHLOR EPOXIDE	0.084	0.00065 U	0.022	2	0.053	0.0356	0.084	0.022
8080S ISODRIN	0.029	0.00065 U	0.00055 U	1	0.029	0.0101	0.029	0.029
8080S METHOXYCHLOR	0.022	0.0032 U	0.0027 U	1	0.022	0.0093	0.022	0.022
ORGANOPHOSPHORUS PESTICIDES								
814ZS DISULFOTON	0.055 U	0.065 U	0.055 U	0		0.0583		
814ZS ETHYL PARATHION	0.0415 U	0.0485 U	0.0405 U	0		0.0435		
814ZS METHYL PARATHION	0.0085 U	0.0046 J	0.008 U	1	0.0046	0.00703	0.005	0.005
HERBICIDES								
815ZS 2,4,5-T	0.011 U	0.013 U	0.0105 U	0		0.0115		
815ZS 2,4,5-TP (SILVEX)	0.0095 U	0.011 U	0.009 U	0		0.00983		
815ZS 2,4-D	0.065 U	0.075 U	0.065 U	0		0.0683		
815ZS DINOSEB	0.008 U	0.0095 U	0.008 U	0		0.0085		
CHLORINATED DIOXINS AND FURANS								
8270S DIBENZOFURAN	0.55 U	0.6 U	0.55 U	0		0.567		
8270S DCDD	1.1 U	1.25 U	1.05 U	0		1.13		
8270S DCDF	1.1 U	1.25 U	1.05 U	0		1.13		
8270S TRCDF	1.1 U	1.25 U	1.05 U	0		1.13		
SOWZS TCDF	R	R	R	0				

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
D - Diluted sample.
F - Estimated maximum concentration.

TABLE 4-2
CRANSTON SITE
PRODUCTION AREA
INORGANIC SHALLOW SOIL DATA

	AREA/SUB AREA	AOC-13/C27(S)	AOC13/A25	AOC13/A40	AOC13/AA7	AOC13/C27	AOC13/C41	AOC13/E45	AOC13/G47	AOC13/J30	AOC13/J35	AOC13/J40	AOC13/J40
	SAMPLE ID	SF-A13-C27(S)*II-2	SF-A13-A25(S)*IB-1	SF-A13-A40(S)*IB-1	SF-A13-AA7(S)*IB-2	SF-A13-C27(S)*IB-2	SF-A13-C41(S)*IB-2	SF-A13-E45(S)*IB-1	SF-A13-G47(S)*IB-2	SF-A13-J30(S)*IB-1	SF-A13-J35(S)*IB-1	SF-A13-J40(S)*IB-1	SF-A13-J40(S)*IB-2
	SAMPLE DATE	5/4/94	11/15/90	11/14/90	3/15/91	3/14/91	3/14/91	11/14/90	3/14/91	11/14/90	11/14/90	11/14/90	3/14/91
	DEPTH RANGE (ft)	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
TOTAL METALS													
6010S	BARIUM	NA	92.3 J	99.9 J	11.6	83.3	86.7	101 J	29.7	51.7 J	80.1 J	106 J	90.5
6010S	BERYLLIUM	NA	0.61	0.73	0.17	0.44	0.43	0.47	0.29	0.51	0.49	0.37	0.41
6010S	CADMIUM	NA	1.1	3.9	0.205 U	1.7	0.67	1.1	0.5	0.84	1.2	1.5	1.1
6010S	CALCIUM	NA	47500 J	44200 J	706	38700	13600	42500 J	7470	25400 J	46200 J	54400 J	58500
6010S	CHROMIUM	NA	15.8 J	26.5 J	3.3 J	16.9 J	9.72 J	14.7 J	9 J	9.4 J	18.6 J	30 J	30.7 J
6010S	COBALT	NA	4.4	6	2.2	4.4	3.1	3.9	3.3	3.2	3.9	4.6	4.6
6010S	COPPER	NA	54.4	46.9	5.9 J	34.4 J	12.6 J	17.9	11.6 J	37.7	16.7	23.8	23.5 J
6010S	IRON	NA	10900 J	21300 J	7210	14400	10300	12000 J	9820	9070 J	12000 J	14600 J	13700
6010S	MAGNESIUM	NA	3080	3860	1110	2560 J	3510 J	4210	1860 J	1740	2880	3690	5360 J
6010S	MANGANESE	NA	239 J	359 J	155 J	200 J	238 J	204 J	160 J	150 J	224 J	205 J	230 J
6010S	NICKEL	NA	12.4 J	26.6 J	3.1	15.9	5.2	11.4	6.3	10.2 J	9 J	18.7 J	9.8
6010S	POTASSIUM	NA	1030 J	1240 J	990 J	1160 J	836 J	932 J	763 J	1100 J	1100 J	1260 J	1250 J
6010S	SODIUM	NA	101 U	120 U	140	312	254	109.5 U	192	104 U	127 U	127 U	329
6010S	VANADIUM	NA	17.2	108	5.4	31.9	11.8	16.5	9.6	18.8	16.6	14.9	18.1
6010S	ZINC	NA	215 J	236 J	22.7 J	261 J	98.1 J	163 J	42.1 J	333 J	245 J	185 J	208 J
7060S	ARSENIC	3.1 J	9.4 J	9.4 J	4.7	125	8.4	7.9 J	7.6	5.6 J	5.8 J	8.5 J	11.5
7421S	LEAD	NA	69.5	162	10.2 J	88.3 J	59.7 J	93	29.6 J	378	55.7	87.5	282 J
7472S	MERCURY	NA	0.31	0.75	0.025 U	0.47	0.24	0.74	1.5	0.22	0.65	1.2	1.1
7841S	THALLIUM	NA	0.28 U	0.21 U	0.2 U	0.175 U	0.185 U	0.245 U	0.24 U	0.19 U	0.23 U	0.22 U	0.22 U
9010S	CYANIDE	NA	0.78	0.26 U	0.22 U	0.215 U	0.22 U	3.5	0.225 U	0.79	0.28 U	0.26 U	0.22 U
SNZZS	TIN	NA	6.1 U	25.6	4.15 U	3.95 U	4.65 U	55.15 U	4.4 U	4.5 U	5.45 U	3.8 U	4.9 U

All results in mg/kg (ppm).
All undetected results listed at half detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.

TABLE 4-2
CRANSTON SITE
PRODUCTION AREA
INORGANIC SHALLOW SOIL DATA

	AREA/SUB AREA	AOC13/L32	AOC13/L37	AOC13/O10	AOC13/O10	AOC13/O25	AOC13/Q27	AOC13/T10	AOC13/T10	AOC13/Y5	AOC13/Y5	SWMU2/B2E1	SWMU3/B3F1	SWMU7/B7B
	SAMPLE ID	SF-A13-L32(S)*IB-2	SF-A13-L37(S)*IB-2	SF-A13-O10(S)*IB-1	SF-A13-O10(S)*IB-2	SF-A13-O25(S)*IB-1	SF-A13-Q27(S)*IB-2	SF-A13-T10(S)*IB-1	SF-A13-T10(S)*IB-2	SF-A13-Y5(S)*IB-1	SF-DUP-1*IB-1	B-2E1*II-1	B-3F1*II-1	B-7B*IB-1
	SAMPLE DATE	3/15/91	3/15/91	11/14/90	3/14/91	12/6/90	3/15/91	11/14/90	3/14/91	11/14/90	11/14/90	7/9/93	7/12/93	11/20/90
	DEPTH RANGE (ft)	*.5 to 1*	*.5 to 1*	*.5 to 1*	*.5 to 1*	*.5 to 1*	*.5 to 1*	*.5 to 1*	*.5 to 1*	*.5 to 1*	*.5 to 1*	*0 to 2*	*0 to 2*	*0 to 2*
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
TOTAL METALS														
6010S	BARIUM	71.9	19.9	44.5 J	29.9	25.3	61.3	39.2 J	37.6	6 J	4.6 J	31.7 J	29.5 J	21
6010S	BERYLLIUM	0.36	0.21	0.51	0.261	0.31	0.36	0.35	0.37	0.26	0.27	0.71	0.61	0.38
6010S	CADMIUM	0.41	0.205 U	0.85	0.225 U	0.19 U	0.37	0.52	0.205 U	0.205 U	0.24 U	0.28	0.28	0.6
6010S	CALCIUM	18900	4740	4740 J	4920	3830 J	31800	9740 J	3760	207 J	250 J	NA	NA	5590 J
6010S	CHROMIUM	8.2 J	2.5 J	16 J	9.3 J	9.2	11.3 J	12.6 J	26.7 J	0.9 J	0.475 U	5.4	5.4	6
6010S	COBALT	4.2	2.3	4	2.7	2.7	3.3	3.2	3	0.41 U	0.475 U	2.7 J	2.6 J	2.6
6010S	COPPER	12.7 J	4.6 J	76.1	18.9 J	9.3	17.6 J	11.1	17 J	0.8 U	0.95 U	5.9	11.5	6.7
6010S	IRON	9390	5890	19400 J	11400	8640	11900	9790 J	10200	4450 J	3390 J	NA	NA	7170
6010S	MAGNESIUM	1690	827	1420	1180 J	1350 J	2280	1930	1410 J	183	158	NA	NA	1230 J
6010S	MANGANESE	149 J	96 J	258 J	125 J	136 J	157 J	134 J	123 J	66.4 J	42.9 J	NA	NA	122 J
6010S	NICKEL	5	3.1	15.9 J	8.1	3.35 U	10.8	10.4 J	6.2	0.8 U	0.95 U	3.6 J	4.5	5.9
6010S	POTASSIUM	1100 J	927 J	499 J	472 J	502 J	994 J	631 J	806 J	389 J	142.5 U	NA	NA	739 J
6010S	SODIUM	213	174	56.5 U	180	90.2	248	114.5 U	192	41 U	47.5 U	NA	NA	58.5 U
6010S	VANADIUM	9.9	5.4	20.1	10.8	10.8	35	10.1	13	0.8 U	0.95 U	7.6	10.1	9.7
6010S	ZINC	641 J	24.1 J	100 J	68.8 J	33.3	509 J	759 J	239 J	20.6 J	13.5 J	37.1 J	48.7 J	87.2 J
7060S	ARSENIC	4.9	2	7.6 J	4.8	7.3 J	6.9	6.6 J	7.2	1 J	1.9 J	0.86 J	0.52 J	4.2 J
7421S	LEAD	49.6 J	5.9 J	24.8	20.4 J	23.8 J	51.9 J	26.8	27.8 J	0.75 U	1.9 U	6.8 J	14 J	15
7472S	MERCURY	0.21	0.025 U	0.96	1.4	0.025 U	0.44	0.22	0.14	0.025 U	0.025 U	NA	1.6 J	0.15
7841S	THALLIUM	0.16 U	0.175 U	0.225 U	0.18 U	0.16 U	0.175 U	0.225 U	0.215 U	0.19 U	0.225 U	NA	0.035 U	0.24 U
9010S	CYANIDE	0.56	0.225 U	3.8	0.19 U	12.6 J	0.22 U	4.6	0.225 U	0.245 U	0.23 U	NA	1.75 U	0.235 U
SNZZS	TIN	3.25 U	4.15 U	4.5 U	4.5 U	3.8 U	3.1 U	4.4 U	4.1 U	4.1 U	4.75 U	NA	NA	4.5 U

All results in mg/kg (ppm).
All undetected results listed at half detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.

TABLE 4-
CRANSTON SITE
PRODUCTION AREA
INORGANIC SHALLOW SOIL DATA

	AREA/SUB AREA	SWMU7/B7B	SWMU7/B7D1	SWMU7/B7D1	SWMU7/B7E1	SWMU7/B7F1	SWMU7/B7G1	SWMU7/B7H1	SWMU8/B8A	SWMU8/B8B	SWMU8/B8B	SWMU8/B8H1	SWMUs & AOC-13 SUMMARY				
	SAMPLE ID	B-7B*IB-2	B-7D1*II-1	B-DUP2*II-1	B-7E1*II-1	B-7F1*II-1	B-7G1*II-1	B-7H1*II-1	B-8A*IB-1	B-8B*IB-1	B-8B*IB-2	B-8H1*II-1					
	SAMPLE DATE	3/18/91	7/23/93	7/29/93	7/23/93	7/23/93	7/23/93	7/23/93	11/20/90	11/20/90	3/14/91	7/24/93					
	DEPTH RANGE (ft)	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2					
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
TOTAL METALS																	
6010S	BARIUM	29.4 J	5 J	9.6 J	NA	NA	NA	NA	27.8	37.1	49.6	28.9 J	31	46.5	46.5	106	4.6
6010S	BERYLLIUM	0.3 J	0.09 J	0.045 U	NA	NA	NA	NA	0.64	0.69	0.53	0.22 J	30	0.412	0.4	0.73	0.09
6010S	CADMIUM	0.59	0.13 U	0.14 U	NA	NA	NA	NA	0.24 U	0.24 U	0.205 U	0.15 U	18	0.973	0.648	3.9	0.28
6010S	CALCIUM	10700 J	NA	NA	NA	NA	NA	NA	6170 J	8440 J	45600	NA	26	20700	20700	58500	207
6010S	CHROMIUM	8.5 J	1.05 U	2.6	NA	NA	NA	NA	6.3	8.3	12.9 J	6.8	29	11.8	11.1	30.7	0.9
6010S	COBALT	2.3	0.38 J	0.93 J	NA	NA	NA	NA	2.6	2.4	4.3	3.5 J	29	3.22	3.04	6	0.38
6010S	COPPER	11.1	3.7	4.3	NA	NA	NA	NA	6.5	11.2	19.7 J	11.1	29	18.8	17.6	76.1	3.7
6010S	IRON	8490 J	NA	NA	NA	NA	NA	NA	7240	8030	11600	NA	26	10500	10500	21300	3390
6010S	MAGNESIUM	2600	NA	NA	NA	NA	NA	NA	1120 J	1170 J	2580 J	NA	26	2110	2110	5360	158
6010S	MANGANESE	145 J	NA	NA	NA	NA	NA	NA	110 J	133 J	179 J	NA	26	167	167	359	42.9
6010S	NICKEL	8.4	1.5 J	1.5 J	NA	NA	NA	NA	3.7	5.1	7.2	6.4	28	8.43	7.77	26.6	1.5
6010S	POTASSIUM	645	NA	NA	NA	NA	NA	NA	696 J	685 J	1000 J	NA	25	870	842	1260	389
6010S	SODIUM	150	NA	NA	NA	NA	NA	NA	95 U	106.5 U	234	NA	13	208	151	329	90.2
6010S	VANADIUM	8.45 U	1.4 J	2.5 J	NA	NA	NA	NA	7.5	8.4	16.5	6.6 J	28	16.2	15	108	1.4
6010S	ZINC	178	13	18.5	NA	NA	NA	NA	136 J	339 J	321 J	96.1	31	184	184	759	13
7060S	ARSENIC	5.3 J	0.085 U	0.42 U	NA	NA	NA	NA	8.1 J	2.5 J	9.2	0.07 U	29	9.92	9.01	125	0.52
7421S	LEAD	23.6	3.6 J	4.3 J	NA	NA	NA	NA	19	23	16 J	9.1	29	58	54.3	378	3.6
747ZS	MERCURY	0.26	0.045 U	0.05 U	NA	NA	NA	NA	0.11	0.25	0.62	0.045 U	22	0.615	0.46	1.6	0.11
7841S	THALLIUM	0.22 U	0.04 U	0.26 J	NA	NA	NA	NA	0.195 U	0.215 U	0.2 U	NA	1	0.26	0.198	0.26	0.26
9010S	CYANIDE	0.82 J	1.3 U	1.25 U	1.35 U	1.15 U	11.15 U	1.2 U	1.7	1.2	1	1.15 U	11	2.85	2.85	12.6	0.56
SNZZS	TIN	4.15 U	NA	NA	NA	NA	NA	NA	4.75 U	4.8 U	3.4 U	NA	1	25.6	25.6	25.6	25.6

All results in mg/kg (ppm).
All undetected results listed at half detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.

TABLE 4
CRANSTON SITE
PRODUCTION AREA
INORGANIC SHALLOW SOIL DATA

	AREA/SUB AREA	AAOI15/15A	AAOI15/15B	AAOI15/MW16S	AAOI15/MW16S	AAOI-15 SUMMARY				
	SAMPLE ID	SF-15A*II-1	SF-15B*II-1	SS-MW-16S*IB-1	SS-MW-16S*IB-2					
	SAMPLE DATE	8/10/93	8/10/93	12/5/90	3/14/91	Frequency		Average Reported		
	DEPTH RANGE (ft)	.5 to 1	.5 to 1	.5 to 1	.5 to 1	of	Average	(with 1/2	Maximum	Minimum
		Result Q	Result Q	Result Q	Result Q	Detection	Detected	detection limit)	Detected	Detected
TOTAL METALS										
6010S	BARIUM	12.1 J	17.1 J	13.9	10.7	4	13.5	13.5	17.1	10.7
6010S	BERYLLIUM	0.13 J	0.28 J	0.195 U	0.22	3	0.21	0.206	0.28	0.13
6010S	CADMIUM	0.14 U	0.11 U	0.24 U	0.0748	1	0.0748	0.141	0.0748	0.0748
6010S	CALCIUM	NA	NA	929 J	673	2	801	801	929	673
6010S	CHROMIUM	3.1	8.7	4.5	4.5 J	4	5.2	5.2	8.7	3.1
6010S	COBALT	1.7 J	3.5 J	2.9	2.8	4	2.73	2.73	3.5	1.7
6010S	COPPER	4.7	10.1	2.6	5.6 J	4	5.75	5.75	10.1	2.6
6010S	IRON	NA	NA	10600	9440	2	10000	10000	10600	9440
6010S	MAGNESIUM	NA	NA	1190 J	930 J	2	1060	1060	1190	930
6010S	MANGANESE	NA	NA	106 J	151 J	2	129	129	151	106
6010S	NICKEL	2.5 J	6.9	1.15 U	3.8	3	4.4	3.59	6.9	2.5
6010S	POTASSIUM	NA	NA	826 J	603 J	2	715	715	826	603
6010S	SODIUM	NA	NA	48 U	181	1	181	115	181	181
6010S	VANADIUM	4.1 J	8.4	6.4	6.4	4	6.33	6.33	8.4	4.1
6010S	ZINC	23.7	44.2	20.6	21 J	4	27.4	27.4	44.2	20.6
7060S	ARSENIC	1 J	2.9 J	5.8 J	4.3	4	3.5	3.5	5.8	1
7421S	LEAD	12.9 J	27.9 J	3.3 J	3 J	4	11.8	11.8	27.9	3
747ZS	MERCURY	0.3 J	0.045 U	0.03 U	0.025 U	1	0.3	0.1	0.3	0.3
7841S	THALLIUM	NA	NA	0.245 U	0.18 U	0		0.213		
9010S	CYANIDE	1.75 U	1.85 U	R	0.22 U	0		1.270		
SNZZS	TIN	NA	NA	4.8 U	4.65 U	0		4.730		

All results in mg/kg (ppm).
All undetected results listed at half detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.

TABLE 4-2s
CRANSTON SITE
PRODUCTION AREA
DEEP SOIL
INORGANIC DATA

	AREA/SUB AREA	SWMU2/B2A	SWMU2/B2B	SWMU2/B2B	SWMU2/B2C	SWMU2/B2D	SWMU2/B2G3	SWMU3/B3A	SWMU3/B3A	SWMU3/B3B	SWMU3/B3C	SWMU3/B3D	SWMU3/B3H4	SWMU7/B7A	SWMU7/B7C	SWMU7/B7D4	SWMU7/B7E4	SWMU7/B7F3	SWMU7/B7G4	SWMU7/B7H4	SWMU7/B7H2
	SAMPLE ID	B-2A*IB-1	B-2B*IB-1	B-2B*IB-2	B-2C*IB-2	B-2D*IB-2	B-2G3*II-1	B-3A*IB-1	B-3A*IB-2	B-3B*IB-1	B-3C*IB-2	B-3D*IB-2	B-3H4*II-1	B-7A*IB-1	B-7C*IB-2	B-7D4*II-1	B-7E4*II-1	B-7F3*II-1	B-7G4*II-1	B-7H4*II-1	B-7H2*II-1
	SAMPLE DATE	11/19/90	12/6/90	3/14/91	3/14/91	3/15/91	7/9/93	11/20/90	3/18/91	11/19/90	3/18/91	3/18/91	7/12/93	11/20/90	3/18/91	7/23/93	7/23/93	7/23/93	7/23/93	7/23/93	7/23/93
	DEPTH RANGE (FT)	8 to 10	6 to 8	6 to 8	6 to 8	6 to 8	4 to 6	6 to 8	6 to 8	6 to 8	2 to 4	6 to 8	6 to 8	2 to 4	4 to 6	6 to 8	6 to 8	4 to 6	6 to 8	6 to 8	2 to 4
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
6010S	BARIUM	11.6	24.1	20.1	32.4	35	43.1 J	14.5	7.8 J	12.2	25.8 J	41 J	10.9 J	15	14.4 J	NA	11.9 J	NA	NA	NA	NA
6010S	BERYLLIUM	0.34	0.56	0.07 U	0.2	0.38	0.67	0.31	0.09 U	0.4	0.33 J	0.4 J	0.79	0.25	0.23 J	NA	0.22 J	NA	NA	NA	NA
6010S	CADMIUM	0.25 U	0.56	0.175 U	0.21 U	0.22 U	0.24	0.265 U	0.225 U	0.205 U	0.225 U	0.52	0.16 U	0.24 U	0.22 U	NA	0.135 U	NA	NA	NA	NA
6010S	CALCIUM	584 J	2120 J	608	4450	762	NA	1180 J	829 J	682 J	987 J	24600 J	NA	5070 J	747 J	NA	NA	NA	NA	NA	NA
6010S	CHROMIUM	12.6	16.6	1.6 J	7 J	15.3 J	12.5	9.9	7.8 J	11	7.4 J	9.4 J	8.9	4.9	6.6 J	NA	8.8	NA	NA	NA	NA
6010S	COBALT	8.6	7.7	0.35 U	3.2	7.8	6.4	4.3	3.6	5	3.8	3.2	5.2 J	1.4	3.1	NA	3.8 J	NA	NA	NA	NA
6010S	COPPER	13.2	25.6	1.5 J	7.2 J	19.4 J	20.5	18.2	9.3	9.5	9.4	8.4	19	11.8	8.7	NA	17.9	NA	NA	NA	NA
6010S	IRON	17800	23900	1900	9830	29900	NA	10400	11000 J	13600	9940 J	10600	NA	4350	9920	NA	NA	NA	NA	NA	NA
6010S	MAGNESIUM	3500 J	4210 J	201 J	1660 J	4640	NA	1730 J	1710	2490 J	1290	1760	NA	706 J	1310	NA	NA	NA	NA	NA	NA
6010S	MANGANESE	243 J	330 J	17 J	121 J	240 J	NA	128 J	107 J	211 J	190 J	178 J	NA	63.4 J	91.1 J	NA	NA	NA	NA	NA	NA
6010S	NICKEL	17.6	19.4	0.7 U	6	21	13.2	9.1	7.6	11.2	7.2	7.4	10.1	6.8	7.3	NA	7.7	NA	NA	NA	NA
6010S	POTASSIUM	307 J	528 J	386 J	433 J	711 J	NA	417 J	328	448 J	417	1210	NA	551 J	445	NA	NA	NA	NA	NA	NA
6010S	SODIUM	67.5 U	57.5 U	180	187	268	NA	83 U	141	43 U	149	219	NA	88.5 U	156	NA	NA	NA	NA	NA	NA
6010S	VANADIUM	10.6	15.6	3.8	10.4	17.9	12.2	12.4	5.65 U	9.1	5.3 U	6.75 U	9.9	4.9	5.3 U	NA	6.4	NA	NA	NA	NA
6010S	ZINC	70.8 J	58.6	2.2 J	26.1 J	49.1 J	40.7 J	144 J	19.85 U	38.8 J	42.75 U	318	36.4 J	49.5 J	13.65 U	NA	27	NA	NA	NA	NA
7060S	ARSENIC	8.2 J	11.3 J	1.5	4.8	15	6.3 J	5.6 J	6.4 J	8.6 J	10.4 J	8.5 J	3 J	2.5 J	9.5 J	NA	3.7	NA	NA	NA	NA
7421S	LEAD	11	13.6 J	8.1 J	15 J	15.5 J	16.5 J	11	5.3	11	19.6	13.7	9.9 J	17	16.9	NA	8.2 J	NA	NA	NA	NA
7472S	MERCURY	0.03 U	0.025 U	0.025 U	0.025 U	0.025 U	NA	0.025 U	0.025 U	0.025 U	0.06	0.24	0.04 U	0.11	0.16	NA	0.12	NA	NA	NA	NA
9010S	CYANIDE	0.27 U	R	0.205 U	0.195 U	0.195 U	NA	0.265 U	0.215 U	0.245 U	13.6 J	1 J	1.45 U	0.235 U	11.1 J	1.45 U	0.75 U	1.2 U	1.05 U	1.15 U	1.25 U

All results in mg/kg (ppm).
All undetected results listed at half detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.

TABLE 4-25
CRANSTON SITE
PRODUCTION AREA
DEEP SOIL
INORGANIC DATA

	AREA/SUB AREA	SWMU8/B8C	SWMU8/B8F3	SWMU11/B11A	SWMU11/B11B	SWMU11/B11B	SWMU11/B11C	AOC13/B13A4	AOC13/B13A3	SWMUs & AOC-13 SUMMARY			
	SAMPLE ID	B-8C*IB-2	B-8F3*II-1	B-11A*IB-1	B-11B*IB-1	B-11B*IB-2	B-11C*IB-2	B-13A4*II-1	B-13A3*II-1				
	SAMPLE DATE	3/14/91	7/24/93	12/6/90	11/20/90	3/15/91	3/15/91	7/20/93	7/20/93	Frequency		Average	
	DEPTH RANGE (FT)	4 to 6	4 to 6	3 to 5	3 to 7	3 to 7	5 to 7	6 to 8	4 to 6	of	Average	Reported	Maximum
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Detection	Detected	(with 1/2 detection limit)	Detected
6010S	BARIUM	26.6	45.3 J	16.2	25.2	25.5	21.4	NA	NA	21	22.9	22.9	45.3
6010S	BERYLLIUM	0.33	0.41 J	0.47	0.49	0.39	0.27	NA	NA	19	0.392	0.362	0.79
6010S	CADMIUM	0.26 U	0.17 U	0.21 U	0.21 U	0.2 U	0.23 U	0.14 U	0.155 U	3	0.44	0.236	0.56
6010S	CALCIUM	173	NA	104 J	4910 J	7770	1040	NA	NA	17	3330	3330	24600
6010S	CHROMIUM	0.6 J	12.1	4.3	8.2	6.8 J	19 J	5.8	10.3	23	9.02	9.02	19
6010S	COBALT	0.35	6.4	2.5	4.5	2.9	3	NA	NA	20	4.34	4.15	8.6
6010S	COPPER	0.81 J	48.7	1.8	8	8.4 J	5.8 J	11	7.7	23	12.7	12.7	48.7
6010S	IRON	925	NA	9500	10300	8840	15000	NA	NA	17	11600	11600	29900
6010S	MAGNESIUM	108 J	NA	900 J	1340 J	1220	1100	NA	NA	17	1760	1760	4640
6010S	MANGANESE	15.2 J	NA	141 J	200 J	159 J	120 J	NA	NA	17	150	150	330
6010S	NICKEL	0.63	15.7	1.7 U	5.2	4	4.8	8.4	6.7	21	9.38	8.67	21
6010S	POTASSIUM	73 J	NA	536 J	658 J	637 J	1040 J	NA	NA	17	537	537	1210
6010S	SODIUM	29.5	NA	118 U	182.5 U	331	350	NA	NA	10	201	156	350
6010S	VANADIUM	0.88	9.7 J	6.9	8.5	8.8	7.2	NA	NA	17	9.13	8.48	17.9
6010S	ZINC	3.2 J	135	30.1	39.9 J	38.2 J	28.2 J	49 J	106 J	20	64.5	59.4	318
7060S	ARSENIC	7	3.3 J	5.9 J	6.9 J	3.3	4.5	1.9 J	0.87 J	23	6.04	6.04	15
7421S	LEAD	7.1 J	23.6	6.1 J	11	6.8 J	4.3 J	NA	NA	21	12	12	23.6
7472S	MERCURY	0.33	0.45	0.025 U	0.34	0.18	1.6	0.04 U	0.045 U	10	0.359	0.179	1.6
9010S	CYANIDE	0.24 U	1 U	R	0.25 U	0.21 U	0.21 U	1.25 U	1.05 U	3	8.57	1.48	13.6

All results in mg/kg (ppm).
All undetected results listed at half detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.

TABLE
CRANSTON SITE
PRODUCTION AREA
DEEP SOIL
INORGANIC DATA

AREA/SUB AREA			AAOI15/MW16S	AAOI15/MW16S	AAOI15/B15A	AAOI-15 SUMMARY				
SAMPLE ID			SS-MW-16S*IB-1	SS-MW-16S*IB-2	B-15A*IB-2					
SAMPLE DATE			12/5/90	3/14/91	3/14/91	Frequency		Average		
DEPTH RANGE (FT)		Minimum	8 to 10	8 to 10	2 to 4	of	Average	Reported	Maximum	Minimum
		Detected	Result Q	Result Q	Result Q	Detection	Detected	(with 1/2 detection limit)	Detected	Detected
6010S	BARIUM	7.8	13.9	10.7	23.4	3	16	16	23.4	10.7
6010S	BERYLLIUM	0.2	0.095 U	0.22	3.8	2	2.01	1.37	3.8	0.22
6010S	CADMIUM	0.24	0.24 U	0.0748	0.21 U	1	0.0748	0.175	0.0748	0.0748
6010S	CALCIUM	104	929 J	673	1180	3	927	927	1180	673
6010S	CHROMIUM	0.6	4.5	4.5 J	9.2 J	3	6.07	6.07	9.2	4.5
6010S	COBALT	0.35	2.9	2.8	4	3	3.23	3.23	4	2.8
6010S	COPPER	0.81	2.6	5.6 J	9.8 J	3	6	6	9.8	2.6
6010S	IRON	925	10600	9440	10600	3	10200	10200	10600	9440
6010S	MAGNESIUM	108	1190 J	930 J	1340 J	3	1150	1150	1340	930
6010S	MANGANESE	15.2	106 J	151 J	211 J	3	156	156	211	106
6010S	NICKEL	0.63	1.15 U	3.8	6.3	2	5.05	3.75	6.3	3.8
6010S	POTASSIUM	73	826 J	603 J	648 J	3	692	692	826	603
6010S	SODIUM	29.5	48 U	181	184	2	183	138	184	181
6010S	VANADIUM	0.88	6.4	6.4	14.7	3	9.17	9.17	14.7	6.4
6010S	ZINC	2.2	20.6	21 J	41.2 J	3	27.6	27.6	41.2	20.6
7060S	ARSENIC	0.87	5.8 J	4.3	11.2	3	7.1	7.1	11.2	4.3
7421S	LEAD	4.3	3.3 J	3 J	20.5 J	3	8.93	8.93	20.5	3
747ZS	MERCURY	0.06	0.03 U	0.025 U	0.11	1	0.11	0.055	0.11	0.11
9010S	CYANIDE	1	R	0.22 U	0.21 U	0		0.143		

All results in mg/kg (ppm).
All undetected results listed at half detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.

TABLE 4-29
CRANSTON SITE
WASTE WATER TREATMENT AREA
DEEP SOIL
INORGANIC DATA

	AREA/SUB AREA	SMU10/B10A	SMU10/B10B	SMU10/B10C	SMU10/B10C	SMU10/B10D	SMU10/B10E	SMU12/B12A2	SMU12/B12D2	SMU12/B12E2	SMU12/B12B3	SMU12/B12C3	SMU12/B12E3	SUMMARY				
	SAMPLE ID	B-10A*IB-1	B-10B*IB-1	B-10C*IB-1	B-10C*IB-2	B-10D*IB-2	B-10E*IB-2	B-12A2*II-1	B-12D2*II-1	B-12E2*II-1	B-12B3*II-1	B-12C3*II-1	B-12E3*II-1					
	SAMPLE DATE	12/5/90	12/5/90	12/5/90	3/13/91	3/13/91	3/13/91	7/25/93	7/25/93	7/26/93	7/25/93	7/25/93	7/26/93					
	DEPTH RANGE (ft)	2 to 4	2 to 4	2 to 4	2 to 4	2 to 4	2 to 4	2 to 4	2 to 4	2 to 4	4 to 6	4 to 6	4 to 6	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q					
TOTAL METALS																		
6010S	BARIUM	32	18.5	19.2	12.4	12.7	13.6	NA	NA	NA	24.1 J	NA	NA	7	18.9	18.9	32	12.4
6010S	BERYLLIUM	0.66	0.69	0.64	0.71	0.81	0.75	NA	NA	NA	0.055 U	NA	NA	6	0.71	0.616	0.81	0.64
6010S	CALCIUM	2460 J	1170 J	1100 J	763	733	924	NA	NA	NA	NA	NA	NA	6	1190	1190	2460	733
6010S	CHROMIUM	8.4	7.7	7	5.5 J	4.8 J	5.8 J	NA	NA	NA	8.3	NA	NA	7	6.79	6.79	8.4	4.8
6010S	COBALT	3.9	3.9	4.5	3.5	4.5	4.3	NA	NA	NA	2.8 J	NA	NA	7	3.91	3.91	4.5	2.8
6010S	COPPER	4.5	5.5	6	9.1 J	10.1 J	9.5 J	11.6	15.6	18.7	58.7	14.4	22.9	12	15.6	15.6	58.7	4.5
6010S	IRON	11500	12800	11200	10100	13300	13300	NA	NA	NA	NA	NA	NA	6	12000	12000	13300	10100
6010S	MAGNESIUM	1270 J	1990 J	1530 J	1370	1260	1400	NA	NA	NA	NA	NA	NA	6	1470	1470	1990	1260
6010S	MANGANESE	148 J	185 J	167 J	177 J	168 J	159 J	NA	NA	NA	NA	NA	NA	6	167	167	185	148
6010S	NICKEL	1.75 U	2.2 U	1.8 U	5	4.5	5.4	NA	NA	NA	5.4	NA	NA	4	5.08	3.72	5.4	4.5
6010S	POTASSIUM	1010 J	1170 J	1020 J	802 J	915 J	902 J	NA	NA	NA	NA	NA	NA	6	970	970	1170	802
6010S	SILVER	0.44 U	0.39 U	0.415 U	0.315 U	0.42 U	0.435 U	0.31 J	0.14 U	0.48 J	0.55 J	0.135 U	0.44 J	4	0.445	0.373	0.55	0.31
6010S	SODIUM	111.5 U	39 U	41.5 U	139	157	215	NA	NA	NA	NA	NA	NA	3	170	117	215	139
6010S	VANADIUM	10.3	7.7	6.7	7.9	6.9	7.4	NA	NA	NA	7.4 J	NA	NA	7	7.76	7.76	10.3	6.7
6010S	ZINC	59.9	50.3	33.9	40.6 J	66.9 J	53 J	NA	NA	NA	132	NA	NA	7	62.4	62.4	132	33.9
7060S	ARSENIC	4.2 J	3.2 J	2.9 J	5.3	4.7	4.5	NA	NA	NA	3.9 J	NA	NA	7	4.1	4.1	5.3	2.9
7421S	LEAD	9.8 J	7.1 J	8.1 J	5.4 J	5.9 J	14.5 J	NA	NA	NA	35.7 J	NA	NA	7	12.4	12.4	35.7	5.4
7477S	MERCURY	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	NA	NA	NA	0.2	NA	NA	1	0.2	0.05	0.2	0.2
9010S	CYANIDE	R	R	R	0.43	0.235 U	0.96	NA	NA	NA	1.5 U	NA	NA	2	0.695	0.781	0.96	0.43

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.

TABLE 4
CRANSTON SITE
WARWICK AREA
SWMU-5
SHALLOW SOIL
ORGANIC DATA

	AREA/SUB AREA	SWMU5/B5A1	SWMU5/B5B1	SWMU5/B5C1	SWMU5/B5D1	SWMU5/B5E1	SWMU5/B5F1	SWMU5/A2	SWMU5/B3	SWMU5/C1	SWMU5/C1	SWMU5/C2	SWMU5/C2	SWMU5/C3
	SAMPLE ID	B-5A1*II-1	B-5B1*II-1	B-5C1*II-1	B-5D1*II-1	B-5E1*II-1	B-5F1*II-1	SF-S5-A2(D)*IB-2	SF-S5-B3(D)*IB-2	SF-S5-C1(D)*IB-1	SF-S5-C1(D)*IB-2	SF-S5-C2(D)*IB-1	SF-S5-C2(D)*IB-2	SF-S5-C3(D)*IB-1
	SAMPLE DATE	7/28/93	7/28/93	7/28/93	7/28/93	7/28/93	7/29/93	3/19/91	3/19/91	11/15/90	3/19/91	11/15/90	3/19/91	11/15/90
	DEPTH RANGE (ft)	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2	1.5 to 2	1.5 to 2	1.5 to 2	1.5 to 2	1.5 to 2	1.5 to 2	1.5 to 2
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
VOLATILE ORGANICS														
	HALOGENATED													
8240S	1,1-DICHLOROETHANE	0.0026 U	0.0027 U	0.00285 U	0.00265 U	0.00265 U	0.0027 U	0.06 U	0.06 U	0.07 U	0.065 U	0.06 U	0.065 U	0.06 U
8240S	CHLOROBENZENE	0.0026 U	0.0027 U	0.00285 U	0.00265 U	0.00265 U	0.0027 U	0.06 U	0.06 U	0.043 J	2.6	3.6	1.2	2
8240S	CHLOROFORM	0.0026 U	0.0027 U	0.00285 U	0.00265 U	0.00265 U	0.0027 U	0.06 U	0.06 U	0.07 U	0.065 U	0.06 U	0.065 U	0.06 U
8240S	METHYLENE CHLORIDE	0.0026 U	0.0135 U	0.025 J	0.0065 U	0.019	0.0027 U	1.35 U	0.1 U	0.07 U	0.325 U	0.09 U	0.08 U	0.115 U
8240S	TETRACHLOROETHENE	0.0026 U	0.0027 U	0.02 J	0.00265 U	0.00265 U	0.0027 U	0.06 U	0.06 U	0.07 U	0.031 J	0.044 J	0.073 J	0.037 J
8240S	TRICHLOROETHENE	0.0026 U	0.0027 U	0.00285 U	0.00265 U	0.00265 U	0.0027 U	0.06 U	0.06 U	0.07 U	0.041 J	0.06 U	0.065 U	0.06 U
	AROMATICS													
8240S	BENZENE	0.0026 U	0.0027 U	0.00285 U	0.00265 U	0.00265 U	0.0027 U	0.06 U	0.06 U	0.07 U	0.065 U	0.06 U	0.065 U	0.06 U
8240S	ETHYLBENZENE	0.0026 U	0.0027 U	0.00285 U	0.00265 U	0.00265 U	0.0027 U	0.06 U	0.06 U	0.07 U	0.065 U	0.06 U	0.065 U	0.06 U
8240S	M&P-XYLENE	0.0026 U	0.0027 U	0.00285 U	0.00265 U	0.00265 U	0.0065	0.042 J	0.06 U	0.07 U	0.026 J	0.065 J	0.03 J	0.041 J
8240S	O-XYLENE	0.0026 U	0.0027 U	0.00285 U	0.00265 U	0.00265 U	0.0027 U	0.06 U	0.06 U	0.07 U	0.065 U	0.046 J	0.017 J	0.022 J
8240S	TOLUENE	0.0026 U	0.0027 U	0.0075 J	0.00265 U	0.00265 U	0.0069	0.06 U	0.06 U	0.1 J	0.18 J	1	1 J	1
	KETONES/ALDEHYDES													
8240S	2-BUTANONE	0.013 U	0.0135 U	0.0145 U	0.013 U	0.0135 U	0.0135 U	0.12 U	0.115 U	0.14 U	0.23 J	0.125 U	0.18 J	0.12 U
8240S	ACETONE	0.013 U	0.0135 U	0.0145 U	0.013 U	0.0135 U	0.0135 U	0.32 J	0.115 U	0.14 U	0.125 U	0.125 U	0.135 U	0.12 U
SEMI-VOLATILE ORGANICS														
	BASE NEUTRALS													
	PAHs													
8270S	2-METHYLNAPHTHALENE	0.014 J	0.02 J	0.19 U	0.175 U	0.014 J	0.175 U	0.6 U	0.6 U	7 U	0.36 J	6 U	0.17 J	0.6 U
8270S	ACENAPHTHENE	0.17 U	0.084 J	0.19 U	0.175 U	0.016 J	0.175 U	0.6 U	0.6 U	7 U	0.16 J	6 U	0.65 U	0.6 U
8270S	ACENAPHTHYLENE	0.061 J	0.11 J	0.19 U	0.175 U	0.067 J	0.175 U	0.6 U	0.6 U	7 U	0.65 U	6 U	0.65 U	0.6 U
8270S	ANTHRACENE	0.13 J	0.32 J	0.19 U	0.175 U	0.092 J	0.031 J	0.6 U	0.6 U	7 U	0.25 J	6 U	0.16 J	0.089 J
8270S	BENZO(A)ANTHRACENE	0.48 J	0.77 J	0.49 J	0.12 U	0.4 J	0.14 J	0.6 U	0.41 J	1.2 J	1.2 J	1.1 J	0.94 J	0.53 J
8270S	BENZO(A)PYRENE	0.44 J	0.69 J	0.33 J	0.025 J	0.41	0.12 J	0.6 U	0.6 U	1.7 J	1.2 J	6 U	1.1 J	0.53 J
8270S	BENZO(B)FLUORANTHENE	0.6 J	0.86 J	0.78 J	0.042 J	0.55	0.16 J	0.6 U	0.6 U	2.6 J	2.6	1.9 J	2.2	1 J
8270S	BENZO(G,H,I)PERYLENE	0.29 J	0.45 J	0.32 J	0.175 U	0.26 J	0.064 J	0.6 U	0.6 U	7 U	0.65 U	6 U	1.2 J	0.52 J
8270S	BENZO(K)FLUORANTHENE	0.213 J	0.35 J	0.18 J	0.12 U	0.23 J	0.062 J	0.6 U	0.6 U	3.4 J	3.2	2.4 J	2.7	1.3
8270S	CHRYSENE	0.43 J	0.69 J	0.76 J	0.175 U	0.44 J	0.12 J	0.6 U	0.6 U	2 J	1.6	1.6 J	0.65 U	0.75 J
8270S	DIBENZ(A,H)ANTHRACENE	0.09 J	0.13 J	0.115 U	0.105 U	0.083 J	0.11 U	0.6 U	0.6 U	7 U	0.65 U	6 U	0.65 U	0.6 U
8270S	FLUORANTHENE	0.9	1.6	0.19 U	0.038 J	0.98	0.27 J	0.6 U	0.65 J	3.6 J	2.1	2.6 J	1.5	1.3
8270S	FLUORENE	0.035 J	0.15 J	0.2 J	0.175 U	0.039 J	0.175 U	0.6 U	0.6 U	7 U	0.23 J	6 U	0.65 U	0.052 J
8270S	INDENO(1,2,3-CD)PYRENE	0.3 J	0.46 J	0.115 U	0.105 U	0.29	0.07 J	0.6 U	0.6 U	7 U	0.65 U	6 U	0.76 J	0.4 J
8270S	NAPHTHALENE	0.046 J	0.064 J	3.5	0.175 U	0.039 J	0.036 J	0.6 U	0.12 J	1.9 J	1.2 J	3.2 J	2.1	0.42 J
8270S	PHENANTHRENE	0.51	1.4	1.2	0.175 U	0.6	0.18 J	0.6 U	0.36 J	1.7 J	1.4	1.4 J	0.64 J	0.72 J
8270S	PYRENE	1.2 J	2.1 J	2.4 J	0.053 J	0.9	0.34 J	0.6 U	0.76 J	3 J	2.8	2 J	1.5	1.1 J
	PHTHALATES													
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	0.46 J	0.33 J	24 J	0.43 J	0.12 J	0.49 J	0.6 U	0.6 U	110	0.65 U	27	0.65 U	2
8270S	BUTYLBENZYLPHTHALATE	0.052 J	0.054 J	0.22 J	0.175 U	0.046 J	0.175 U	0.6 U	0.6 U	7 U	0.65 U	6 U	0.65 U	0.78 J
8270S	DI-N-BUTYLPHTHALATE	0.17 U	0.175 U	0.19 U	0.175 U	0.175 U	0.175 U	0.6 U	0.6 U	7 U	0.65 U	6 U	0.65 U	0.057 J
8270S	DI-N-OCTYLPHTHALATE	0.04 J	0.045 J	7.7 J	0.23 J	0.175 U	0.175 U	0.6 U	0.6 U	18	0.65 U	6.6 J	0.65 U	0.2 J
	HALOGENATED													
8270S	1,2-DICHLOROBENZENE	0.17 U	0.175 U	0.19 U	0.175 U	0.175 U	0.175 U	0.6 U	0.6 U	7 U	0.65 U	6 U	0.65 U	0.6 U
8270S	1,4-DICHLOROBENZENE	0.17 U	0.039 J	0.19 U	0.175 U	0.032 J	0.175 U	0.6 U	0.6 U	7 U	0.65 U	6 U	0.65 U	0.6 U
8270S	4-CHLOROANILINE	1.6	0.45 J	2.6	1.1	0.35 U	0.355 U	0.6 U	0.6 U	1.6 J	0.65 U	7.4 J	1.3	0.31 J
8270S	BIS(2-CHLOROETHYL)ETHER	0.17 U	0.175 U	0.19 U	0.175 U	0.175 U	0.175 U	0.6 U	0.6 U	7 U	0.65 U	6 U	0.33 J	0.43 J
	OTHER BASE NEUTRALS													
8270S	DIBENZOFURAN	0.17 U	0.052 J	0.19 U	0.175 U	0.175 U	0.175 U	0.6 U	0.6 U	7 U	0.2 J	6 U	0.65 U	0.068 J
8270S	NITROBENZENE	0.17 U	0.175 U	2.9	0.175 U	0.175 U	0.175 U	0.6 U	0.6 U	7 U	0.65 U	6 U	0.48 J	0.6 U
8270S	2-NITROANILINE	0.9 U	0.9 U	7	0.9 U	0.9 U	0.9 U	3 U	2.9 U	34.5 U	3.15 U	31 U	0.98 J	3 U
8270S	1,1-BIPHENYL	NA	NA	1.9	NA	0.175 U	NA	NA	NA	NA	NA	NA	NA	NA
8270S	3,3'-DIMETHYLBENZIDINE	0.105 U	0.11 U	0.115 U	0.105 U	0.105 U	0.11 U	1.2 U	1.15 U	13.5 U	1.25 U	12.5 U	1.3 U	1.2 U
8270S	PHENACETIN	0.17 U	0.175 U	0.19 U	0.175 U	0.175 U	0.175 U	0.6 U	0.6 U	7 U	0.65 U	6 U	0.65 U	0.6 U
8270S	N-NITROSO-DI-N-PROPYLAMINE	0.105 U	0.11 U	0.115 U	0.105 U	0.105 U	0.11 U	0.6 U	0.6 U	7 U	0.65 U	6 U	0.65 U	0.6 U
	ACID EXTRACTABLES													
	PHENOLS													
8270S	3&4-METHYLPHENOL	0.022 J	0.175 U	0.19 U	0.175 U	0.175 U	0.175 U	NA	NA	NA	NA	NA	NA	NA
8270S	PHENOL	0.17 U	0.175 U	0.19 U	0.175 U	0.175 U	0.175 U	0.6 U	0.42 J	0.89 J	0.65 U	6 U	0.65 U	0.6 U
FINGERPRINT COMPOUNDS														
8270S	PROPAZINE	NA	NA	NA	NA	NA	NA	3 U	2.9 U	34.5 U	3.15 U	31 U	3.25 U	3 U
8270S	TINUVIN 327	NA	NA	NA	NA	NA	NA	3 U	2.9 U	34.5 U	3.15 U	18 J	3.7 J	0.57 J
PCBs														
8080S	PCB-1248	0.085 U	0.0355 U	0.95 U	8.1 J	0.035 U	0.0175 U	0.006 U	0.29 U	R	0.6 U	12.5 U	49	0.305 U
8080S	PCB-1254	0.72	0.28 J	4.9 J	6.1 J	0.035 U	0.0175 U	0.0115 U	12	R	36 J	25 U	R	0.6 U
ORGANOCHLORINE PESTICIDES														
8080S	4,4'-DDD	0.018	0.00355 U	0.095 U	0.0175 U	0.0035 U	0.00175 U	0.0006 U	0.029 U	R	0.06 U	1.25 U	R	0.0305 U
8080S	4,4'-DDE	0.0085 U	0.0091	0.65 J	0.0175 U	0.0035 U	0.00175 U	0.0006 U	0.029 U	0.22 J	0.06 U	1.25 U	R	0.0305 U
8080S	4,4'-DDT	0.03 J	0.0085 J	0.095 U	0.0175 U	0.0078 J	0.0052 J	0.00096 J	0.06 U	R	0.115 U	2.5 U	R	0.51
8080S	ALDRIN	0.0044 U	0.0018 U	0.049 U	0.009 U	0.0018 U	0.0009 U	0.0006 U	0.029 U	0.13 J	0.06 U	1.25 U	R	0.0305 U
8080S	ALPHA-BHC	0.0044 U	0.0018 U	0.049 U	0.009 U	0.0018 U	0.0009 U	0.0006 U	0.029 U	R	0.06 U	1.25 U	R	0.076
8080S	ALPHA-CHLORDANE	0.077	0.0018 U	0.049 U	0.009 U	0.0018 U	0.004 J	0.0006 U	0.029 U	R	0.06 U	1.25 U	R	0.0305 U
8080S	DELTA-BHC	0.0044 U	0.0018 U	0.049 U	0.009 U	0.0018 U	0.0009 U	0.0006 U	0.029 U	0.26 J	0.06 U	1.25 U	R	0.0305 U
8080S	DIELDRIN	0.0085 U	0.00355 U	0.095 U	0.063 J	0.0035 U	0.00175 U	0.0006 U	0.029 U	R	0.06 U	1.25 U	R	0.0305 U
8080S	ENDOSULFAN I	0.0044 U	0.0018 U	0.049 U	0.009 U	0.0018 U	0.0009 U	0.0006 U	0.029 U	R	0.06 U	1.25 U	R	0.0305 U
8080S	ENDOSULFAN II	0.018 J	0.00355 U	0.095 U	0.0175 U	0.0035 U	0.00175 U	0.00175 U	0.085 U	R	0.175 U	3.75 U	R	0.09 U
8080S	ENDOSULFAN SULFATE	0.0085 U	0.0075 J	0.095 U	0.0175 U	0.0035 U	0.00175 U	0.0029 U	0.145 U	R	0.295 U	6 U	R	0.29 J
8080S	ENDRIN	0.0085 U	0.00355 U	0.095 U	0.0175 U	0.0035 U	0.00175 U	0.0006 U	0.029 U	R	0.06 U	1.25 U	R	0.065
8080S	ENDRIN ALDEHYDE	0.0085 U	0.00355 U	0.4 J	0.0175 U	0.0035 U	0.00175 U	0.00115 U	0.06 U	R	0.115 U	2.5 U	R	3.5
8080S	GAMMA-CHLORDANE	0.11 J	0.0057 J	0.049 U	0.087 J	0.0018 U	0.004 J	0.0006 U	0.029 U	R	0.06 U	1.25 U	R	0.21
8080S	HEPTACHLOR EPOXIDE	0.017 J	0.0018 U	0.16 J	0.042 J	0.0018 U	0.0009 U	0.0006 U	0.029 U	R	0.06 U	1.25 U	R	0.25
8080S	ISODRIN	0.0085 U	0.00355 U	0.095 U	0.0175 U	0.0035 U	0.00175 U	0.0006 U	0.029 U	R	0.06 U	1.25 U	R	0.0305 U
8080S	KEPONE	0.044 U	0.018 U	0.49 U	0.26 J	0.018 U	0.009 U	0.0006 U	0.029 U	R	0.06 U	1.25 U	R	0.0305 U
8080S	METHOXYCHLOR	0.044 U	0.55 J	110 J	0.09 U	0.65	0.009 U	0.0029 U	1.8	R	0.295 U	2200	1100 J	3.3
ORGANOPHOSPHORUS PESTICIDES														
814ZS	DISULFOTON	0.07 U	0.07 U	0.15 U	0.07 U	0.07 U	0.07 U	0.06 U	0.055 U	0.07 U	0.06 U	0.06 U	0.007 J	0.0077 J
814ZS	PHORATE	0.017 U	0.0175 U	0.038 U	0.0175 U	0.0175 U	0.0175 U	0.0435 U	0.0415 U	0.05 U	0.0465 U	0.047 U	0.0485 U	0.0096 J
814ZS	SULFOTEPP	0.009 U	0.009 U	0.0195 U	0.009 U	0.009 U	0.009 U	0.029 U	0.0275 U	0.0345 U	0.031 U	0.031 U	0.0325 U	0.03 U
814ZS	THIONAZIN	0.017 U	0.0175 U	0.038 U	0.0175 U	0.0175 U	0.0175 U	0.29 U	0.275 U	0.345 U	0.31 U	0.0058 J	0.325 U	0.3 U
HERBICIDES														
815ZS	2,4,5-T	0.009 U	0.009 U	0.049 U	0.009 U	0.009 U	0.009 U	0.012 U	0.0115 U	0.0135 U	0.0125 U	0.0125 U	0.0095 J	0.012 U
815ZS	2,4,5-TP (SILVEX)	0.009 U	0.009 U	0.049 U	0.009 U	0.009 U	0.009 U	0.01 U	0.01 U	0.11	0.011 U	0.0105 U	0.34	0.01 U
815ZS	DINOSEB	NA	NA	NA	NA	NA	NA	0.009 U	0.0085 U	0.01 U	0.0095 U	0.009 U	0.072	0.009 U

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration

TABLE 4
CRANSTON SITE
WARWICK AREA
SWMU-5
SHALLOW SOIL
ORGANIC DATA

	AREA/SUB AREA	SWMU5/C4	SWMU5/D2	SWMU5/D3	SWMU5/E3	SWMU5/YY3	SWMU5/ZZ3	SWMU-5/5G1	SWMU-5/5G1	SWMU-5/5H1	SWMU 5 SUMMARY				
	SAMPLE ID	SF-S5-C4(D)*IB-2	SF-S5-D2(D)*IB-1	SF-S5-D3(D)*IB-1	SF-S5-E3(D)*IB-2	SF-S5-YY3(S)*IB-2	SF-S5-ZZ3(D)*IB-2	B-5G1*II-2	B-DUP1*II-2	B-5H1*II-2					
	SAMPLE DATE	3/19/91	11/15/90	11/15/90	3/19/91	3/19/91	3/19/91	5/5/94	5/5/94	5/5/94					
	DEPTH RANGE (ft)	1.5 to 2	1.5 to 2	1.5 to 2	1.5 to 2	.5 to 1	.5 to 1	0 to 2	0 to 2	0 to 2					
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
VOLATILE ORGANICS															
	HALOGENATED														
8240S	1,1-DICHLOROETHANE	0.055 U	0.06 U	0.065 U	0.044 J	0.06 U	0.155 U	NA	NA	NA	1	0.044	0.0471	0.044	0.044
8240S	CHLOROBENZENE	0.055 U	0.12	0.82	0.065 U	0.06 U	1.7	NA	NA	NA	8	1.51	0.653	3.6	0.043
8240S	CHLOROFORM	0.055 U	0.06 U	0.065 U	0.048 J	0.06 U	0.155 U	NA	NA	NA	1	0.048	0.0473	0.048	0.048
8240S	METHYLENE CHLORIDE	1.3 U	0.175 U	0.135 U	1.3 U	0.95 U	0.265 U	NA	NA	NA	2	0.022	0.333	0.025	0.019
8240S	TETRACHLOROETHENE	0.055 U	0.06 U	0.063 J	2.4	0.06 U	0.35	NA	NA	NA	8	0.377	0.179	2.4	0.02
8240S	TRICHLOROETHENE	0.055 U	0.06 U	0.065 U	0.13	0.06 U	0.155 U	NA	NA	NA	2	0.0855	0.0504	0.13	0.041
	AROMATICS														
8240S	BENZENE	0.055 U	0.06 U	0.065 U	0.034 J	0.06 U	0.155 U	NA	NA	NA	1	0.034	0.0466	0.034	0.034
8240S	ETHYLBENZENE	0.055 U	0.06 U	0.065 U	0.027 J	0.06 U	0.155 U	NA	NA	NA	1	0.027	0.0462	0.027	0.027
8240S	M&P-XYLENE	0.055 U	0.06 U	0.065 U	0.07 J	0.06 U	0.155 U	NA	NA	NA	7	0.0401	0.0431	0.07	0.0065
8240S	O-XYLENE	0.055 U	0.06 U	0.065 U	0.041 J	0.06 U	0.155 U	NA	NA	NA	4	0.0315	0.0417	0.046	0.017
8240S	TOLUENE	0.32 J	0.12	0.36	0.54 J	0.3 J	1.8 J	NA	NA	NA	13	0.518	0.361	1.8	0.0069
	KETONES/ALDEHYDES														
8240S	2-BUTANONE	0.11 U	0.12 U	0.13 U	0.13 U	0.115 U	0.31 U	NA	NA	NA	2	0.205	0.107	0.23	0.18
8240S	ACETONE	0.11 U	0.12 U	0.13 U	0.13 U	0.115 U	0.31 U	NA	NA	NA	1		0.109	0.32	0.32
SEMI-VOLATILE ORGANICS															
	BASE NEUTRALS														
	PAHs														
8270S	2-METHYLNAPHTHALENE	0.55 U	6 U	6.5 U	0.65 U	0.6 U	0.25 J	NA	NA	NA	6	0.138	1.6	0.36	0.014
8270S	ACENAPHTHENE	0.55 U	6 U	6.5 U	0.65 U	0.6 U	0.6 U	NA	NA	NA	3	0.0867	1.65	0.16	0.016
8270S	ACENAPHTHYLENE	0.55 U	6 U	6.5 U	0.65 U	0.6 U	0.6 U	NA	NA	NA	3	0.0793	1.67	0.11	0.061
8270S	ANTHRACENE	0.2 J	6 U	6.5 U	0.2 J	0.6 U	0.19 J	NA	NA	NA	10	0.166	1.54	0.32	0.031
8270S	BENZO(A)ANTHRACENE	0.43 J	6 U	1.6 J	1 J	0.6 U	0.93 J	NA	NA	NA	15	0.775	0.997	1.6	0.14
8270S	BENZO(A)PYRENE	0.55 U	6 U	1.5 J	1.1 J	0.6 U	0.96 J	NA	NA	NA	13	0.777	1.29	1.7	0.025
8270S	BENZO(B)FLUORANTHENE	0.55 U	6 U	2.8 J	1.6	0.6 U	1 J	NA	NA	NA	14	1.34	1.42	2.8	0.042
8270S	BENZO(G,H,I)PERYLENE	0.55 U	6 U	6.5 U	0.96 J	0.6 U	0.92 J	NA	NA	NA	9	0.554	1.77	1.2	0.064
8270S	BENZO(K)FLUORANTHENE	0.55 U	6 U	3.6 J	1.9	0.6 U	1.2	NA	NA	NA	13	1.6	1.54	3.6	0.062
8270S	CHRYSENE	0.43 J	6 U	2.3 J	1.2 J	0.6 U	1.3	NA	NA	NA	13	1.05	1.17	2.3	0.12
8270S	DIBENZ(A,H)ANTHRACENE	0.55 U	6 U	6.5 U	0.65 U	0.6 U	0.6 U	NA	NA	NA	3	0.101	1.66	0.13	0.083
8270S	FLUORANTHENE	0.85 J	1.5 J	3.7 J	2	0.6 U	1.7	NA	NA	NA	16	1.58	1.4	3.7	0.038
8270S	FLUORENE	0.55 U	6 U	6.5 U	0.65 U	0.6 U	0.19 J	NA	NA	NA	7	0.128	1.6	0.23	0.035
8270S	INDENO(1,2,3-CD)PYRENE	0.55 U	6 U	6.5 U	0.86 J	0.6 U	0.75 J	NA	NA	NA	8	0.486	1.72	0.86	0.07
8270S	NAPHTHALENE	0.13 J	6 U	1.2 J	0.43 J	0.14 J	2.5	NA	NA	NA	16	1.06	1.25	3.5	0.036
8270S	PHENANTHRENE	0.72 J	0.74 J	1.4 J	0.81 J	0.6 U	0.73 J	NA	NA	NA	16	0.907	0.836	1.7	0.18
8270S	PYRENE	0.77 J	1.7 J	3 J	1.7	0.6 U	1.7	NA	NA	NA	17	1.59	1.49	3	0.053
	PHTHALATES														
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	0.55 U	3.1 J	140	0.65 U	0.6 U	1.7 U	NA	NA	NA	11	28	16.5	140	0.12
8270S	BUTYLBENZYLPHTHALATE	0.55 U	6 U	6.5 U	0.65 U	0.6 U	0.6 U	NA	NA	NA	5	0.23	1.68	0.78	0.046
8270S	DI-N-BUTYLPHTHALATE	0.55 U	6 U	6.5 U	0.65 U	0.6 U	0.6 U	NA	NA	NA	1	0.057	1.66	0.057	0.057
8270S	DI-N-OCTYLPHTHALATE	0.55 U	6 U	23	0.65 U	0.6 U	0.6 U	NA	NA	NA	8	6.98	3.53	23	0.04
	HALOGENATED														
8270S	1,2-DICHLOROBENZENE	0.55 U	6 U	6.5 U	0.18 J	0.6 U	0.6 U	NA	NA	NA	1	0.18	1.66	0.18	0.18
8270S	1,4-DICHLOROBENZENE	0.55 U	6 U	6.5 U	0.65 U	0.6 U	0.6 U	NA	NA	NA	2	0.0355	1.67	0.039	0.032
8270S	4-CHLOROANILINE	0.55 U	6 U	5.4 J	0.65 U	0.6 U	1.4	NA	NA	NA	10	2.32	1.76	7.4	0.31
8270S	BIS(2-CHLOROETHYL)ETHER	0.55 U	6 U	6.5 U	0.65 U	0.6 U	0.6 U	NA	NA	NA	2	0.38	1.66	0.43	0.33
	OTHER BASE NEUTRALS														
8270S	DIBENZOFURAN	0.55 U	6 U	6.5 U	0.65 U	0.6 U	0.6 U	NA	NA	NA	3	0.107	1.63	0.2	0.052
8270S	NITROBENZENE	0.55 U	6 U	6.5 U	0.65 U	0.6 U	0.6 U	NA	NA	NA	2	1.69	1.82	2.9	0.48
8270S	2-NITROANILINE	2.7 U	30.5 U	32 U	3.25 U	2.9 U	3.1 U	NA	NA	NA	2	3.99	8.66	7	0.98
8270S	1,1-BIPHENYL	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	1.9	1.04	1.9	1.9
8270S	3,3'-DIMETHYLBENZIDINE	1.1 U	12 U	12.5 U	1.3 U	1.15 U	6.6	NA	NA	NA	1	6.6	3.55	6.6	6.6
8270S	PHENACETIN	0.55 U	6 U	6.5 U	0.65 U	0.6 U	1 J	NA	NA	NA	1	1	1.71	1	1
8270S	N-NITROSO-DI-N-PROPYLAMINE	0.55 U	6 U	6.5 U	0.65 U	0.6 U	0.17 J	NA	NA	NA	1	0.17	1.64	0.17	0.17
	ACID EXTRACTABLES														
	PHENOLS														
8270S	3&4-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	0.022	0.152	0.022	0.022
8270S	PHENOL	0.55 U	6 U	6.5 U	0.65 U	0.6 U	0.35 J	NA	NA	NA	3		1.34	0.89	0.35
FINGERPRINT COMPOUNDS															
8270S	PROPAZINE	2.7 U	24 J	32 U	3.25 U	2.9 U	3.1 U	NA	NA	NA	1	24	11.4	24	24
8270S	TINUVIN 327	2.7 U	30.5 U	4.1 J	3.25 U	2.9 U	6.4	NA	NA	NA	5		8.9	18	0.57
PCBs															
8080S	PCB-1248	0.0055 U	0.6 U	1.3 U	0.0315 U	0.006 U	160 J	0.09 U	0.195 U	0.039 U	3	72.4	11.2	160	8.1
8080S	PCB-1254	0.073	1.25 U	2.55 U	0.065 U	0.71	R	0.09 U	0.195 U	0.21	9		4.78	36	0.073
ORGANOCHLORINE PESTICIDES															
8080S	4,4'-DDD	0.00055 U	0.41	0.13 U	0.00315 U	0.0006 U	R	0.009 U	0.0195 U	0.0039 U	2	0.214	0.11	0.41	0.018
8080S	4,4'-DDE	0.00055 U	0.06 U	0.13 U	0.041	0.0006 U	R	0.004 J	0.0195 U	0.0039 U	5	0.185	0.127	0.65	0.004
8080S	4,4'-DDT	0.00105 U	0.125 U	0.255 U	0.0065 U	0.00115 U	R	0.009 U	0.0195 U	0.0039 U	6	0.0937	0.198	0.51	0.00096
8080S	ALDRIN	0.00055 U	1.1	1 J	0.00315 U	0.0006 U	R	0.00475 U	0.01 U	0.002 U	3	0.743	0.184	1.1	0.13
8080S	ALPHA-BHC	0.00055 U	0.15	0.27 J	0.00315 U	0.0006 U	1.2	0.00475 U	0.01 U	0.002 U	4	0.424	0.156	1.2	0.076
8080S	ALPHA-CHLORDANE	0.00055 U	0.06 U	0.13 U	0.00315 U	0.0006 U	R	0.00475 U	0.01 U	0.03	3	0.037	0.0922	0.077	0.004
8080S	DELTA-BHC	0.00055 U	0.06 U	0.13 U	0.00315 U	0.0034	R	0.00475 U	0.01 U	0.002 U	2	0.132	0.0955	0.26	0.0034
8080S	DIELDRIN	0.00055 U	0.06 U	0.91 J	0.018	0.0006 U	R	0.009 U	0.0195 U	0.0039 U	3	0.33	0.135	0.91	0.018
8080S	ENDOSULFAN I	0.00055 U	0.06 U	0.13 U	0.00315 U	0.0006 U	R	0.01 J	0.01 J	0.018 J	3	0.0127	0.0879	0.018	0.01
8080S	ENDOSULFAN II	0.0016 U	0.185 U	0.385 U	0.0095 U	0.00175 U	R	0.009 U	0.0195 U	0.0039 U	1	0.018	0.256	0.018	0.018
8080S	ENDOSULFAN SULFATE	0.00265 U	0.28 J	0.65 U	0.016 U	0.0029 U	R	0.009 U	0.0195 U	0.0039 U	3	0.193	0.413	0.29	0.0075
8080S	ENDRIN	0.00055 U	0.12	0.54 J	0.00315 U	0.0006 U	R	0.009 U	0.0195 U	0.0039 U	3	0.242	0.117	0.54	0.065
8080S	ENDRIN ALDEHYDE	0.00105 U	0.125 U	0.255 U	0.0065 U	0.00115 U	R	0.009 U	0.0195 U	0.0039 U	2	1.95	0.37	3.5	0.4
8080S	GAMMA-CHLORDANE	0.00055 U	0.5	0.13 U	0.00315 U	0.0006 U	R	0.00475 U	0.01 U	0.024 J	7	0.134	0.131	0.5	0.004
8080S	HEPTACHLOR EPOXIDE	0.00055 U	1.2	0.13 U	0.08	0.0006 U	R	0.00475 U	0.01 U	0.002 U	6	0.292	0.171	1.2	0.017
8080S	ISODRIN	0.00055 U	0.06 U	0.85 J	0.00315 U	0.0006 U	R	0.009 U	0.0195 U	0.0039 U	1	0.85	0.129	0.85	0.85
8080S	KEPONE	0.00055 U	0.06 U	0.13 U	0.00315 U	0.0006 U	R	0.0475 U	0.1 U	0.02 U	1	0.26	0.135	0.26	0.26
8080S	METHOXYCHLOR	0.00265 U	0.305 U	0.65 U	2.5	0.0029 U	320 J	0.86 J	12 J	0.092	12		179	2200	0.092
ORGANOPHOSPHORUS PESTICIDES															
814ZS	DISULFOTON	0.05 U	0.06 U	R	0.065 U	0.055 U	0.06 U	NA	NA	NA	2	0.00735	0.0617	0.0077	0.007
814ZS	PHORATE	0.0395 U	0.0455 U	R	0.048 U	0.043 U	0.046 U	NA	NA	NA	1	0.0096	0.0352	0.0096	0.0096
814ZS	SULFOTEPP	0.026 U	0.0305 U	0.0041 J	0.032 U	0.0285 U	0.0305 U	NA	NA	NA	1	0.0041	0.0227	0.0041	0.0041
814ZS	THIONAZIN	0.26 U	0.305 U	R	0.32 U	0.285 U	0.305 U	NA	NA	NA	1	0.0058	0.192	0.0058	0.0058
HERBICIDES															
815ZS	2,4,5-T	0.011 U	0.012 U	0.013 U	0.013 U	0.0115 U	0.0125 U	NA	NA	NA	1	0.0095	0.0132	0.0095	0.0095
815ZS	2,4,5-TP (SILVEX)	0.0095 U	0.0105 U	0.21	0.02 J	0.01 U	0.011 U	NA	NA	NA	4	0.17	0.0456	0.34	0.02
815ZS	DINOSEB	0.0085 U	0.009 U	0.0095 U	0.0095 U	0.0085 U	0.0095 U	NA	NA	NA	1	0.072	0.014	0.072	0.072

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration

TABLE 4-31
CRANSTON SITE
WARWICK AREA
SWMU-6, -9, AND -16
SHALLOW SOIL
ORGANIC DATA

AREA/SUB AREA		SWMU6/A1	SWMU6/B1	SWMU6/Y5	SWMU6/Y5	SWMU 6 SUMMARY					SWMU9/B2B	SWMU9/C1	SWMU9/C1	SWMU9/C2	SWMU9/ZZ1	SWMU9/ZZ2	SWMU 9 SUMMARY				
SAMPLE ID		SF-S6-A1*IB-2	SF-S6-B1*IB-2	SF-S6*IB-1	SF-S6*IB-2						SF-S9-B2(S)*IB-1	SF-S9-C1(S)*IB-1	SF-S9-C1(S)*IB-2	SF-S9-C2(S)*IB-1	SF-S9-ZZ1(S)*IB-2	SF-S9-ZZ2(S)*IB-2					
SAMPLE DATE		3/12/91	3/12/91	11/14/90	3/12/91						11/15/90	11/15/90	3/12/91	11/15/90	3/12/91	3/12/91					
DEPTH RANGE (ft)		.5 to 1	.5 to 1	.5 to 1	.5 to 1	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	.5 to 1	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
		Result Q	Result Q	Result Q	Result Q						Result Q	Result Q	Result Q	Result Q	Result Q	Result Q					
VOLATILE ORGANICS																					
	HALOGENATED																				
8240S	CHLOROBENZENE	0.05 U	0.05 U	0.05 U	0.055 U	0		0.0513			0.055 U	0.05 U	0.05 U	0.055 U	0.055 U	0.055 U	0		0.0533		
8240S	METHYLENE CHLORIDE	0.05 U	0.075 U	0.05 U	0.13 U	0		0.0763			0.055 U	0.05 U	0.115 U	0.105 U	0.215 U	0.185 U	0		0.121		
8240S	TETRACHLOROETHENE	0.05 U	0.05 U	0.05 U	0.055 U	0		0.0513			0.055 U	0.05 U	0.05 U	0.055 U	0.055 U	0.055 U	0		0.0533		
	AROMATICS																				
8240S	TOLUENE	0.05 U	0.05 U	0.05 U	0.055 U	0		0.0513			0.047 J	0.05 U	0.05 U	0.04 J	0.029 J	0.032 J	4	0.037	0.0413	0.047	0.029
8240S	M&P-XYLENE	0.05 U	0.05 U	0.05 U	0.055 U	0		0.0513			0.055 U	0.05 U	0.05 U	0.055 U	0.055 U	0.055 U	0		0.0533		
SEMI-VOLATILE ORGANICS																					
	BASE NEUTRALS																				
	PAHs																				
8270S	CHRYSENE	0.5 U	0.5 U	5 U	0.55 U	0		1.64			0.55 U	0.5 U	0.5 U	0.55 U	0.5 U	0.43 J	1	0.43	0.505	0.43	0.43
8270S	FLUORANTHENE	0.5 U	0.5 U	5 U	0.55 U	0		1.64			0.55 U	0.5 U	0.5 U	0.55 U	0.5 U	0.73 J	1	0.73	0.555	0.73	0.73
8270S	PHENANTHRENE	0.5 U	0.5 U	5 U	0.55 U	0		1.64			0.55 U	0.5 U	0.5 U	0.55 U	0.5 U	0.34 J	1	0.34	0.49	0.34	0.34
8270S	PYRENE	0.5 U	0.5 U	5 U	0.55 U	0		1.64			0.55 U	0.5 U	0.5 U	0.55 U	0.5 U	0.7 J	1	0.7	0.55	0.7	0.7
	PHTHALATES																				
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	0.5 U	0.5 U	5 U	0.55 U	0		1.64			0.29 J	0.1 J	0.5 U	0.55 U	0.5 U	0.38 J	3	0.257	0.387	0.38	0.1
8270S	BUTYLBENZYLPHTHALATE	0.5 U	0.5 U	5 U	0.55 U	0		1.64			0.55 U	0.5 U	0.5 U	0.55 U	0.5 U	0.51 J	1	0.51	0.518	0.51	0.51
	OTHER BASE NEUTRALS																				
8270S	SAFROLE	2.3	0.7 J	5 U	0.55 U	2	1.5	2.14	2.3	0.7	0.55 U	0.5 U	0.5 U	0.55 U	4.2	28	2	16.1	5.72	28	4.2
FINGERPRINT COMPOUNDS																					
8270S	TINUVIN 327	2.6 U	2.6 U	8.3 J	2.6 J	2	5.45	4.03	8.3	2.6	6.1	2.5 U	2.55 U	2.65 U	2.6 U	2.75 U	1	6.1	3.19	6.1	6.1
PCBs																					
8080S	PCB-1254	0.099	0.0105 U	0.0105 U	0.13	2	0.115	0.0625	0.13	0.099	0.011 U	0.01 U	0.032	0.011 U	0.062	0.18	3	0.0913	0.051	0.18	0.032
ORGANOCHLORINE PESTICIDES																					
8080S	4,4'-DDE	0.0005 U	0.0005 U	0.0067	0.00055 U	1	0.0067	0.00206	0.0067	0.0067	0.00055 U	0.0005 U	0.0005 U	0.00055 U	0.0005 U	0.00055 U	0		0.000525		
8080S	4,4'-DDT	0.00105 U	0.00105 U	0.00105 U	0.00105 U	0		0.00105			0.0011 U	0.0036	0.001 U	0.003	0.00105 U	0.0011 U	2	0.0033	0.00181	0.0036	0.003
8080S	ALPHA-BHC	0.0005 U	0.0005 U	0.0005 U	0.0017	1	0.0017	0.0008	0.0017	0.0017	0.00055 U	0.0005 U	0.0005 U	0.001 J	0.0005 U	0.00055 U	1	0.001	0.0006	0.001	0.001
8080S	BETA-BHC	0.0005 U	0.0005 U	0.0005 U	0.0096	1	0.0096	0.00278	0.0096	0.0096	0.00055 U	0.0005 U	0.0005 U	0.00055 U	0.0005 U	0.00055 U	0		0.000525		
8080S	DELTA-BHC	0.0005 U	0.0005 U	0.0005 U	0.00055 U	0		0.000513			0.00055 U	0.0005 U	0.0005 U	0.00055 U	0.0005 U	0.00055 U	0		0.000525		
8080S	DIELDRIN	0.0005 U	0.0005 U	0.0005 U	0.00055 U	0		0.000513			0.00055 U	0.0028	0.0005 U	0.0019	0.0005 U	0.00055 U	2	0.00235	0.00113	0.0028	0.0019
8080S	ENDRIN	0.0005 U	0.0005 U	0.0037	0.00055 U	1	0.0037	0.00131	0.0037	0.0037	0.0032	0.0031	0.0005 U	0.00055 U	0.0005 U	0.00055 U	2	0.00315	0.0014	0.0032	0.0031
8080S	ENDRIN ALDEHYDE	0.00105 U	0.00105 U	0.0029	0.00105 U	1	0.0029	0.00151	0.0029	0.0029	0.012	0.001 U	0.001 U	0.0021 J	0.00105 U	0.0011 U	2	0.00705	0.00304	0.012	0.0021
8080S	GAMMA-BHC	0.0005 U	0.0005 U	0.0005 U	0.00055 U	0		0.000513			0.00055 U	0.0005 U	0.0005 U	0.0017	0.0014	0.00055 U	2	0.00155	0.000867	0.0017	0.0014
8080S	GAMMA-CHLORDANE	0.0005 U	0.0005 U	0.0072	0.00055 U	1	0.0072	0.00219	0.0072	0.0072	0.013	0.0005 U	0.0005 U	0.00055 U	0.0005 U	0.00055 U	1	0.013	0.0026	0.013	0.013
8080S	HEPTACHLOR	0.0005 U	0.0005 U	0.0005 U	0.00055 U	0		0.000513			0.00055 U	0.0005 U	0.0005 U	0.0032	0.0005 U	0.00055 U	1	0.0032	0.000967	0.0032	0.0032
8080S	HEPTACHLOR EPOXIDE	0.0005 U	0.0005 U	0.0005 U	0.00055 U	0		0.000513			0.00055 U	0.0005 U	0.0005 U	0.0022	0.0005 U	0.00055 U	1	0.0022	0.0008	0.0022	0.0022
8080S	ISODRIN	0.0005 U	0.0005 U	0.0005 U	0.00055 U	0		0.000513			0.0072	0.0005 U	0.0005 U	0.00055 U	0.0005 U	0.00055 U	1	0.0072	0.00163	0.0072	0.0072
8080S	METHOXYCHLOR	0.0026 U	0.0026 U	0.046	0.00265 U	1	0.046	0.0135	0.046	0.046	0.0028 U	0.00255 U	0.00255 U	0.0027 U	0.0026 U	0.0028 U	0		0.00267		
ORGANOPHOSPHORUS PESTICIDES																					
8147S	DISULFOTON	0.055 U	0.055 U	0.05 U	0.055 U	0		0.0538			0.055 U	0.0059 J	0.05 U	0.055 U	0.055 U	0.055 U	1	0.0059	0.046	0.0059	0.0059
8147S	ETHYL PARATHION	0.0395 U	0.0395 U	0.0385 U	0.04 U	0		0.0394			0.042 U	0.0064 J	0.038 U	0.0056 J	0.0395 U	0.0415 U	2	0.006	0.0288	0.0064	0.0056

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
E - Estimated maximum concentration

TABLE 4-31
CRANSTON SITE
WARWICK AREA
SWMU-6, -9, AND -16
SHALLOW SOIL
ORGANIC DATA

	AREA/SUB AREA	SWMU16/B16E1	AAOI16/MW17S	AAOI16/MW17S	SWMU 16 SUMMARY					F04L/B22	F04L/B22	P-21S/P-21D AREA SUMMARY				
	SAMPLE ID	B-16E1*II-1	SS-MW-17S*IB-1	SS-MW-17S*IB-2						SS-B22-A*IB-1	SS-B22-B*IB-1					
	SAMPLE DATE	7/21/93	12/5/90	3/13/91						12/5/90	12/5/90					
	DEPTH RANGE (ft)	0 to 2	.5 to 1	.5 to 1	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected	.5 to 1	.5 to 1	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
		Result Q	Result Q	Result Q						Result Q	Result Q					
VOLATILE ORGANICS																
	HALOGENATED															
8240S	CHLOROBENZENE	0.0057	0.055 U	0.05 U	1	0.0057	0.0369	0.0057	0.0057	0.055 U	0.065 U	0		0.06		
8240S	METHYLENE CHLORIDE	0.011	0.055 U	0.215 U	1	0.011	0.0937	0.011	0.011	0.055 U	0.065 U	0		0.06		
8240S	TETRACHLOROETHENE	0.009	0.055 U	0.05 U	1	0.009	0.038	0.009	0.009	0.055 U	0.065 U	0		0.06		
	AROMATICS															
8240S	TOLUENE	0.014	0.055 U	0.05 U	1	0.014	0.0397	0.014	0.014	0.055 U	0.065 U	0		0.06		
8240S	M&P-XYLENE	0.011	0.055 U	0.05 U	1	0.011	0.0387	0.011	0.011	0.055 U	0.065 U	0		0.06		
SEMI-VOLATILE ORGANICS																
	BASE NEUTRALS															
	PAHs															
8270S	CHRYSENE	NA	0.5 U	1 U	0		0.75			NA	NA					
8270S	FLUORANTHENE	NA	0.5 U	1 U	0		0.75			NA	NA					
8270S	PHENANTHRENE	NA	0.5 U	1 U	0		0.75			NA	NA					
8270S	PYRENE	NA	0.5 U	1 U	0		0.75			NA	NA					
	PHTHALATES															
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	NA	0.5 U	1 U	0		0.75			NA	NA					
8270S	BUTYLBENZYLPHTHALATE	NA	0.5 U	1 U	0		0.75			NA	NA					
	OTHER BASE NEUTRALS															
8270S	SAFROLE	NA	0.5 U	1 U	0		0.75			NA	NA					
FINGERPRINT COMPOUNDS																
8270S	TINUVIN 327	NA	2.6 U	5 U	0		3.8			NA	NA					
PCBs																
8080S	PCB-1254	0.019 U	0.01 U	0.15	1	0.15	0.0597	0.15	0.15	NA	NA					
ORGANOCHLORINE PESTICIDES																
8080S	4,4'-DDE	0.0019 U	0.000495 U	0.0005 U	0		0.000965			NA	NA					
8080S	4,4'-DDT	0.0039	0.001 U	0.001 U	1	0.0039	0.00197	0.0039	0.0039	NA	NA					
8080S	ALPHA-BHC	0.00095 U	0.000495 U	0.0005 U	0		0.000648			NA	NA					
8080S	BETA-BHC	0.00095 U	0.000495 U	0.0091	1	0.0091	0.00352	0.0091	0.0091	NA	NA					
8080S	DELTA-BHC	0.00095 U	0.000495 U	0.002	1	0.002	0.00115	0.002	0.002	NA	NA					
8080S	DIELDRIN	0.0019 U	0.000495 U	0.0005 U	0		0.000965			NA	NA					
8080S	ENDRIN	0.0019 U	0.000495 U	0.0005 U	0		0.000965			NA	NA					
8080S	ENDRIN ALDEHYDE	0.0019 U	0.001 U	0.001 U	0		0.0013			NA	NA					
8080S	GAMMA-BHC	0.00095 U	0.000495 U	0.0005 U	0		0.000648			NA	NA					
8080S	GAMMA-CHLORDANE	0.00095 U	0.000495 U	0.0005 U	0		0.000648			NA	NA					
8080S	HEPTACHLOR	0.00095 U	0.000495 U	0.0005 U	0		0.000648			NA	NA					
8080S	HEPTACHLOR EPOXIDE	0.00095 U	0.000495 U	0.0005 U	0		0.000648			NA	NA					
8080S	ISODRIN	0.0019 U	0.000495 U	0.0005 U	0		0.000965			NA	NA					
8080S	METHOXYCHLOR	0.0095 U	0.00245 U	0.00255 U	0		0.00483			NA	NA					
ORGANOPHOSPHORUS PESTICIDES																
8142S	DISULFOTON	NA	0.055 U	0.05 U	0		0.0525			NA	NA					
8142S	ETHYL PARATHION	NA	0.0395 U	0.038 U	0		0.0388			NA	NA					

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration

TABLE 4-32
CRANSTON SITE
WARWICK AREA
DEEP SOIL
ORGANIC DATA

AREA/SUB AREA		SWMU5/B5A2	SWMU5/B5B2	SWMU5/B5C2	SWMU5/B5D2	SWMU5/B5E2	SWMU5/B5F2	SWMU-5/5G2	SWMU-5/5H2	SWMU 5 SUMMARY					SWMU9/B9A3	SWMU9/B9B2	SWMU9/B9A3	SWMU 9 SUMMARY				
SAMPLE ID		B-5A2*II-1	B-5B2*II-1	B-5C2*II-1	B-5D2*II-1	B-5E2*II-1	B-5F2*II-1	B-5G2*II-2	B-5H2*II-2						B-9A3*II-1	B-9B2*II-1	B-DUP5*II-1					
SAMPLE DATE		7/28/93	7/28/93	7/28/93	7/28/93	7/28/93	7/29/93	5/5/94	5/5/94						7/27/93	7/27/93	7/27/93					
DEPTH RANGE (ft)		2 to 4	2 to 4	2 to 4	2 to 4	2 to 4	2 to 4	2 to 4	2 to 4	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected	4 to 6	2 to 4	4 to 6	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q						Result Q	Result Q	Result Q					
VOLATILE ORGANICS																						
	HALOGENATED																					
8240S	CHLOROBENZENE	0.00285 U	0.00265 U	510	0.0028 U	0.0067 J	0.0027 U	NA	NA	2	255	85	510	0.0067	0.0029 U	0.007 J	0.00295 U	1	0.007	0.00428	0.007	0.007
8240S	METHYLENE CHLORIDE	0.00285 U	0.0055 U	1.3 J	0.0028 U	0.008 U	0.0079	NA	NA	2	0.654	0.221	1.3	0.0079	0.0029 U	0.0028 U	0.00295 U	0		0.00288		
8240S	TETRACHLOROETHENE	0.00285 U	0.00265 U	2.1	0.0028 U	0.0026 U	0.0089	NA	NA	2	1.05	0.353	2.1	0.0089	0.0029 U	0.0028 U	0.00295 U	0		0.00288		
	AROMATICS																					
8240S	TOLUENE	0.00285 U	0.00265 U	100	0.0028 U	0.0026 U	0.0027 U	NA	NA	1	100	16.7	100	100	0.0029 U	0.0028 U	0.00295 U	0		0.00288		
8240S	M&P-XYLENE	0.00285 U	0.00265 U	11 J	0.0028 U	0.006 J	0.0027 U	NA	NA	2	5.5	1.84	11	0.006	0.0029 U	0.0028 U	0.00295 U	0		0.00288		
8240S	O-XYLENE	0.00285 U	0.00265 U	6.7 J	0.0028 U	0.0026 U	0.0027 U	NA	NA	1	6.7	1.12	6.7	6.7	0.0029 U	0.0028 U	0.00295 U	0		0.00288		
SEMI-VOLATILE ORGANICS																						
	BASE NEUTRALS																					
	PAHs																					
8270S	2-METHYLNAPHTHALENE	0.19 U	0.02 J	0.11 J	0.185 U	0.17 U	0.18 U	NA	NA	2	0.065	0.143	0.11	0.02	0.01 J	0.018 J	0.017 J	3	0.015	0.015	0.018	0.01
8270S	ACENAPHTHENE	0.19 U	0.053 J	0.41 J	0.185 U	0.17 U	0.18 U	NA	NA	2	0.232	0.198	0.41	0.053	0.19 U	0.185 U	0.195 U	0		0.19		
8270S	ACENAPHTHYLENE	0.19 U	0.068 J	0.22 U	0.185 U	0.17 U	0.18 U	NA	NA	1	0.068	0.169	0.068	0.068	0.19 U	0.16 J	0.042 J	2	0.101	0.131	0.16	0.042
8270S	ANTHRACENE	0.032 J	0.25 J	0.22 U	0.185 U	0.17 U	0.1 J	NA	NA	3	0.127	0.16	0.25	0.032	0.19 U	0.24 J	0.195 U	1	0.24	0.208	0.24	0.24
8270S	BENZO(A)ANTHRACENE	0.14 J	0.65 J	1.2 J	0.13 U	0.12 U	0.066 J	NA	NA	4	0.514	0.384	1.2	0.066	0.094 J	1 J	0.11 J	3	0.401	0.401	1	0.094
8270S	BENZO(A)PYRENE	0.14 J	0.56 J	1.2 J	0.13 U	0.12 U	0.054 J	NA	NA	4	0.489	0.367	1.2	0.054	0.067 J	1.1 J	0.06 J	3	0.409	0.409	1.1	0.06
8270S	BENZO(B)FLUORANTHENE	0.19 J	0.77 J	1.9 J	0.13 U	0.12 U	0.07 J	NA	NA	4	0.733	0.53	1.9	0.07	0.16 J	1.6 J	0.18 J	3	0.647	0.647	1.6	0.16
8270S	BENZO(G,H,I)PERYLENE	0.087 J	0.32 J	0.74 J	0.185 U	0.17 U	0.18 U	NA	NA	3	0.382	0.28	0.74	0.087	0.14 J	0.62 J	0.13 J	3	0.297	0.297	0.62	0.13
8270S	BENZO(K)FLUORANTHENE	0.067 J	0.12 J	0.94 J	0.13 U	0.12 U	0.125 U	NA	NA	3	0.376	0.25	0.94	0.067	0.062 J	0.48 J	0.064 J	3	0.202	0.202	0.48	0.062
8270S	CHRYSENE	0.13 J	0.51 J	1.3 J	0.185 U	0.17 U	0.061 J	NA	NA	4	0.5	0.393	1.3	0.061	0.14 J	1.1 J	0.16 J	3	0.467	0.467	1.1	0.14
8270S	DIBENZ(A,H)ANTHRACENE	0.115 U	0.105 U	0.135 U	0.11 U	0.105 U	0.11 U	NA	NA	0		0.113			0.046 J	0.074 J	0.045 J	3	0.055	0.055	0.074	0.045
8270S	FLUORANTHENE	0.27 J	1.1	0.94	0.185 U	0.17 U	0.1 J	NA	NA	4	0.603	0.461	1.1	0.1	0.2 J	1.6	0.26 J	3	0.687	0.687	1.6	0.2
8270S	FLURENE	0.19 U	0.079 J	0.54	0.185 U	0.17 U	0.18 U	NA	NA	2	0.31	0.224	0.54	0.079	0.19 U	0.052 J	0.195 U	1	0.052	0.146	0.052	0.052
8270S	INDENO(1,2,3-CD)PYRENE	0.096 J	0.34 J	0.135 U	0.11 U	0.105 U	0.11 U	NA	NA	2	0.218	0.149	0.34	0.096	0.15 J	0.76 J	0.15 J	3	0.353	0.353	0.76	0.15
8270S	NAPHTHALENE	0.19 U	0.091 J	32	0.185 U	0.17 U	0.062 J	NA	NA	3	10.7	5.45	32	0.062	0.036 J	0.071 J	0.195 U	2	0.0535	0.101	0.071	0.036
8270S	PHENANTHRENE	0.12 J	0.87	2.3	0.033 J	0.17 U	0.073 J	NA	NA	5	0.679	0.594	2.3	0.033	0.23 J	0.91	0.32 J	3	0.487	0.487	0.91	0.23
8270S	PYRENE	0.35 J	1.9 J	6.4 J	0.185 U	0.17 U	0.17 J	NA	NA	4	2.21	1.53	6.4	0.17	0.17 J	2.8 J	0.21 J	3	1.06	1.06	2.8	0.17
	PHTHALATES																					
8270S	BIS(2-ETHYLHEXYL)PHTHALATE	0.1 J	1.1 J	160 J	0.185 U	0.17 U	0.3 J	NA	NA	4	40.4	27	160	0.1	0.19 U	0.185 U	0.195 U	0		0.19		
8270S	BUTYLBENZYLPHTHALATE	0.19 U	0.074 J	0.22 U	0.185 U	0.17 U	0.18 U	NA	NA	1	0.074	0.17	0.074	0.074	0.19 U	0.185 U	0.195 U	0		0.19		
8270S	DI-N-OCTYLPHTHALATE	0.19 U	0.13 J	89	0.185 U	0.17 U	0.18 U	NA	NA	2	44.6	15	89	0.13	0.19 U	0.185 U	0.195 U	0		0.19		
	HALOGENATED																					
8270S	*4-CHLOROANILINE*	0.098 J	0.78	0.19 J	0.37 U	0.345 U	0.36 U	NA	NA	3	0.356	0.357	0.78	0.098	0.385 U	0.37 U	0.39 U	0		0.382		
	OTHER BASE NEUTRALS																					
8270S	DIBENZOFURAN	0.19 U	0.04 J	0.22 U	0.185 U	0.17 U	0.18 U	NA	NA	1	0.04	0.164	0.04	0.04	0.19 U	0.034 J	0.036 J	2	0.035	0.0867	0.036	0.034
8270S	DIPHENYLAMINE	0.19 U	0.175 U	0.14 J	0.185 U	0.17 U	0.18 U	NA	NA	1	0.14	0.173	0.14	0.14	0.19 U	0.185 U	0.195 U	0		0.19		
8270S	2-NITROANILINE	1 U	0.9 U	0.92 J	0.95 U	0.9 U	0.9 U	NA	NA	1	0.92	0.928	0.92	0.92	1 U	0.95 U	1 U	0		0.983		
	ACID EXTRACTABLES																					
	PHENOLS																					
8270S	2-CHLOROPHENOL	0.19 U	0.175 U	0.24 J	0.185 U	0.17 U	0.18 U	NA	NA	1	0.24	0.19	0.24	0.24	0.19 U	0.185 U	0.195 U	0		0.19		
8270S	3&4-METHYLPHENOL	0.19 U	0.028 J	0.22 U	0.185 U	0.17 U	0.18 U	NA	NA	1	0.028	0.162	0.028	0.028	0.19 U	0.185 U	0.195 U	0		0.19		
8270S	PHENOL	0.19 U	0.175 U	5	0.185 U	0.17 U	0.18 U	NA	NA	1	5	0.983	5	5	0.19 U	0.185 U	0.195 U	0		0.19		
FINGERPRINT COMPOUNDS																						
8270S	TINUVIN 328	NA	NA	NA	NA	NA	NA	NA	NA	0					0.19 U	0.55 J	0.195 U	1	0.55	0.312	0.55	0.55
PCBs																						
8080S	PCB-1254	0.14 J	0.35 U	2.2 U	0.0185 U	0.017 U	0.018 U	4.05 U	0.0185 U	1	0.14	0.852	0.14	0.14	0.019 U	0.0185 U	0.0195 U	0		0.019		
ORGANOCHLORINE PESTICIDES																						
8080S	4,4'-DDD	0.0019 U	0.035 U	0.22 U	0.00185 U	0.0017 U	0.0018 U	0.23 J	0.00185 U	1	0.23	0.0618	0.23	0.23	0.0019 U	0.017	0.00195 U	1	0.017	0.00695	0.017	0.017
8080S	4,4'-DDE	0.0019 U	0.035 U	0.22 U	0.00185 U	0.0017 U	0.0036 J	0.23 J	0.017 J	3	0.0835	0.0639	0.23	0.0036	0.0019 U	0.0042 J	0.00195 U	1	0.0042	0.00268	0.0042	0.0042
8080S	4,4'-DDT	0.0079 J	0.035 U	0.22 U	0.00185 U	0.0017 U	0.01 J	0.405 U	0.048 J	3	0.022	0.0912	0.048	0.0079	0.0019 U	0.0084 J	0.0076 J	2	0.008	0.00597	0.0084	0.0076
8080S	ALPHA-BHC	0.001 U	0.018 U	0.115 U	0.00095 U	0.0009 U	0.0009 U	0.21 U	0.00095 U	0		0.0435			0.001 U	0.00095 U	0.001 U	0		0.000983		
8080S	ALPHA-CHLORDANE	0.025	0.018 U	0.115 U	0.00095 U	0.0009 U	0.021	0.21 U	0.00095 U	2	0.023	0.049	0.025	0.021	0.001 U	0.0022 J	0.001 U	1	0.0022	0.0014	0.0022	0.0022
8080S	CHLOROBENZILATE	0.01 U	0.18 U	1.15 U	0.0095 U	0.009 U	0.009 U	2.1 U	0.0095 U	0		0.435			0.01 U	0.0095 U	0.01 U	0		0.00983		
8080S	DELTA-BHC	0.001 U	0.018 U	0.115 U	0.00095 U	0.0009 U	0.0009 U	0.21 U	0.00095 U	0		0.0435			0.001 U	0.00095 U	0.001 U	0		0.000983		
8080S	DIELDRIN	0.0019 U	0.035 U	0.22 U	0.00185 U	0.0017 U	0.0018 U	0.405 U	0.00185 U	0		0.0836			0.0019 U	0.0055 J	0.00195 U	1	0.0055	0.00312	0.0055	0.0055
8080S	ENDOSULFAN I	0.001 U	0.018 U	0.115 U	0.00095 U	0.0009 U	0.0009 U	0.21 U	0.0018 J	1	0.0018	0.0436	0.0018	0.0018	0.001 U	0.00095 U	0.001 U	0		0.000983		
8080S	ENDOSULFAN SULFATE	0.0019 U	0.035 U	0.22 U	0.00185 U	0.0017 U	0.0018 U	0.405 U	0.00185 U	0		0.0836			0.0019 U	0.0074 J	0.00195 U	1	0.0074	0.00375	0.0074	0.0074
8080S	ENDRIN ALDEHYDE	0.0019 U	0.035 U	0.22 U	0.00185 U	0.0017 U	0.0018 U	0.405 U	0.00185 U	0		0.0836			0.0019 U	0.0039 J	0.00195 U	1	0.0039	0.00258	0.0039	0.0039
8080S	GAMMA-CHLORDANE	0.022 J	0.018 U	0.3 J	0.00095 U	0.0009 U	0.017 J	0.21 U	0.00095 U	3	0.113	0.0712	0.3	0.017	0.001 U	0.0024 J	0.001 U	1	0.0024	0.00147	0.0024	0.0024
8080S	HEPTACHLOR EPOXIDE	0.0048 J	0.018 U	0.115 U	0.00095 U	0.0009 U	0.0009 U	0.21 U	0.00095 U	1	0.0048	0.0439	0.0048	0.0048	0.001 U	0.00095 U	0.001 U	0		0.000983		
8080S	METHOXYCHLOR	0.01 U	1.7 J	1800	0.0095 U	0.009 U	0.019 J	160	0.031	5	392	245	1800	0.019	0.067	1.1	0.11 J	3	0.426	0.426	1.1	0.067
CHLORINATED DIOXINS AND FURANS																						
SOWZS	OCDD	NA	NA	0.0039 J	NA	NA	NA	NA	NA	1	0.0039	0.0039	0.0039	0.0039	0.00027 U	0.00018 F	0.000075 U	1	0.00018	0.000175	0.00018	0.00018

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration

TABLE 4-32
CRANSTON SITE
WARWICK AREA
DEEP SOIL
ORGANIC DATA

AREA/SUB AREA	SWMU16/B16B2	SWMU16/B16C2	SWMU16/B16D2	SWMU16/B16E2	SWMU16/B16E2	AOI16/B16A	SWMU16/B16B3	SWMU16/B16C3	SWMU16/B16D3	SWMU 16 SUMMARY					F04L/B22	F04L/B22	F04L SUMMARY					
SAMPLE ID	B-16B2*II-1	B-16C2*II-1	B-16D2*II-1	B-16E2*II-1	B-DUP1*II-1	B-16A*IB-2	B-16B3*II-1	B-16C3*II-1	B-16D3*II-1						SS-B22-B*IB-1	SS-B22-A*IB-1						
SAMPLE DATE	7/21/93	7/21/93	7/21/93	7/21/93	7/22/93	3/13/91	7/21/93	7/21/93	7/21/93						12/5/90	12/5/90						
DEPTH RANGE (ft)	2 to 4	2 to 4	2 to 4	2 to 4	2 to 4	4 to 6	4 to 6	4 to 6	4 to 6						8 to 10	4 to 6						
	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected	Result Q	Result Q	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected	
VOLATILE ORGANICS																						
HALOGENATED																						
8240S CHLOROBENZENE	0.00285 U	0.00285 U	0.0028 U	0.0026 U	0.0026 U	0.055 U	0.0026 U	0.0026 U	0.00255 U	0		0.00849			0.065 U	0.055 U	0		0.06			
8240S METHYLENE CHLORIDE	0.00285 U	0.0096 J	0.012 J	0.0086	0.0054	0.195 U	0.0026 U	0.0026 U	0.0083	5	0.00878	0.0274	0.012	0.0054	0.065 U	0.055 U	0		0.06			
8240S TETRACHLOROETHENE	0.00285 U	0.00285 U	0.0099 J	0.0026 U	0.0072 J	0.055 U	0.0026 U	0.0026 U	0.012	3	0.0097	0.0108	0.012	0.0072	0.065 U	0.055 U	0		0.06			
AROMATICS																						
8240S TOLUENE	0.00285 U	0.00285 U	0.011 J	0.0026 U	0.0069 J	0.028 J	0.0026 U	0.0026 U	0.0085	4	0.0136	0.00754	0.028	0.0069	0.065 U	0.055 U	0		0.06			
8240S M&P-XYLENE	0.00285 U	0.00285 U	0.008 J	0.0026 U	0.0026 U	0.055 U	0.0026 U	0.0026 U	0.011	2	0.0095	0.01	0.011	0.008	0.065 U	0.055 U	0		0.06			
8240S O-XYLENE	0.00285 U	0.00285 U	0.0028 U	0.0026 U	0.0026 U	0.055 U	0.0026 U	0.0026 U	0.00255 U	0		0.00849			0.065 U	0.055 U	0		0.06			
SEMI-VOLATILE ORGANICS																						
BASE NEUTRALS																						
PAHs																						
8270S 2-METHYLNAPHTHALENE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S ACENAPHTHENE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S ACENAPHTHYLENE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S ANTHRACENE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S BENZO(A)ANTHRACENE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S BENZO(A)PYRENE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S BENZO(B)FLUORANTHENE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S BENZO(G,H,I)PERYLENE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S BENZO(K)FLUORANTHENE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S CHRYSENE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S DIBENZ(A,H)ANTHRACENE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S FLUORANTHENE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S FLUORENE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S INDENO(1,2,3-CD)PYRENE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S NAPHTHALENE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S PHENANTHRENE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S PYRENE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
PHTHALATES																						
8270S BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S BUTYLBENZYLPHTHALATE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S DI-N-OCTYLPHTHALATE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
HALOGENATED																						
8270S 4-CHLOROANILINE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
OTHER BASE NEUTRALS																						
8270S DIBENZOFURAN	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S DIPHENYLAMINE	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S 2-NITROANILINE	NA	NA	NA	NA	NA	2.65 U	NA	NA	NA	0		2.65			NA	NA	0					
ACID EXTRACTABLES																						
PHENOLS																						
8270S 2-CHLOROPHENOL	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
8270S 3&4-METHYLPHENOL	NA	NA	NA	NA	NA	NA	NA	NA	NA	0					NA	NA	0					
8270S PHENOL	NA	NA	NA	NA	NA	0.55 U	NA	NA	NA	0		0.55			NA	NA	0					
FINGERPRINT COMPOUNDS																						
8270S TINUVIN 328	NA	NA	NA	NA	NA	NA	NA	NA	NA	0					NA	NA	0					
PCBs																						
8080S PCB-1254	0.019 U	0.019 U	0.0185 U	0.017 U	0.017 U	0.029	0.017 U	0.017 U	0.017 U	1	0.029	0.0189	0.029	0.029	NA	NA	0					
ORGANOCHLORINE PESTICIDES																						
8080S 4,4'-DDD	0.0019 U	0.0019 U	0.00185 U	0.0017 U	0.0017 U	0.00055 U	0.0017 U	0.0017 U	0.0017 U	0		0.00163			NA	NA	0					
8080S 4,4'-DDE	0.0019 U	0.0019 U	0.00185 U	0.0017 U	0.0017 U	0.00055 U	0.0017 U	0.0017 U	0.0017 U	0		0.00163			NA	NA	0					
8080S 4,4'-DDT	0.0019 U	0.0019 U	0.024	0.0017 U	0.0017 U	0.0011 U	0.0017 U	0.0017 U	0.0017 U	1	0.024	0.00416	0.024	0.024	NA	NA	0					
8080S ALPHA-BHC	0.00095 U	0.001 U	0.00095 U	0.0009 U	0.0009 U	0.0016	0.0009 U	0.0009 U	0.00085 U	1	0.0016	0.000994	0.0016	0.0016	NA	NA	0					
8080S ALPHA-CHLORDANE	0.00095 U	0.001 U	0.00095 U	0.0009 U	0.0009 U	0.00055 U	0.0009 U	0.0009 U	0.00085 U	0		0.000878			NA	NA	0					
8080S CHLOROBENZILATE	0.0095 U	0.01 U	0.0095 U	0.009 U	0.046 J	NA	0.009 U	0.009 U	0.0085 U	1	0.046	0.0138	0.046	0.046	NA	NA	0					
8080S DELTA-BHC	0.00095 U	0.001 U	0.00095 U	0.0009 U	0.0009 U	0.0022	0.0009 U	0.0009 U	0.00085 U	1	0.0022	0.00106	0.0022	0.0022	NA	NA	0					
8080S DIELDRIN	0.0019 U	0.0019 U	0.00185 U	0.0017 U	0.0017 U	0.00055 U	0.0017 U	0.0017 U	0.0017 U	0		0.00163			NA	NA	0					
8080S ENDOSULFAN I	0.00095 U	0.001 U	0.00095 U	0.0009 U	0.0009 U	0.00055 U	0.0009 U	0.0009 U	0.00085 U	0		0.000878			NA	NA	0					
8080S ENDOSULFAN SULFATE	0.0019 U	0.0019 U	0.00185 U	0.0017 U	0.0017 U	0.00275 U	0.0017 U	0.0017 U	0.0017 U	0		0.00188			NA	NA	0					
8080S ENDRIN ALDEHYDE	0.0019 U	0.0019 U	0.00185 U	0.0017 U	0.0017 U	0.0011 U	0.0017 U	0.0017 U	0.0017 U	0		0.00169			NA	NA	0					
8080S GAMMA-CHLORDANE	0.00095 U	0.001 U	0.00095 U	0.0009 U	0.0009 U	0.00055 U	0.0009 U	0.0009 U	0.00085 U	0		0.000878			NA	NA	0					
8080S HEPTACHLOR EPOXIDE	0.00095 U	0.001 U	0.00095 U	0.0009 U	0.0009 U	0.00055 U	0.0009 U	0.0009 U	0.00085 U	0		0.000878			NA	NA	0					
8080S METHOXYCHLOR	0.0095 U	0.01 U	0.0095 U	0.033 J	0.009 U	0.00275 U	0.009 U	0.009 U	0.0085 U	1	0.033	0.0111	0.033	0.033	NA	NA	0					
CHLORINATED DIOXINS AND FURANS																						
SOWZS OCDD	NA	NA	NA	0.00014 U	0.000135 U	NA	0.000105 U	NA	NA	0		0.000127	0	0	NA	NA	0					

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration

TABLE 4-2
CRANSTON SITE
WARWICK AREA
SHALLOW SOIL
INORGANIC DATA

AREA/SUB AREA	SWMU5/YY3	SWMU5/ZZ3	SWMU5/B5A1	SWMU5/B5B1	SWMU5/B5C1	SWMU5/B5D1	SWMU5/B5E1	SWMU5/B5F1	SWMU5/A2	SWMU5/B3	SWMU5/C1	SWMU5/C1	SWMU5/C2
SAMPLE ID	SF-S5-YY3(S)*IB-2	SF-S5-ZZ3(D)*IB-2	B-5A1*II-1	B-5B1*II-1	B-5C1*II-1	B-5D1*II-1	B-5E1*II-1	B-5F1*II-1	SF-S5-A2(D)*IB-2	SF-S5-B3(D)*IB-2	SF-S5-C1(D)*IB-1	SF-S5-C1(D)*IB-2	SF-S5-C2(D)*IB-1
SAMPLE DATE	3/19/91	3/19/91	7/28/93	7/28/93	7/28/93	7/28/93	7/28/93	7/29/93	3/19/91	3/19/91	11/15/90	3/19/91	11/15/90
DEPTH RANGE (ft)	.5 to 1	.5 to 1	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2	0 to 2	1.5 to 2	1.5 to 2	1.5 to 2	1.5 to 2	1.5 to 2
	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q
6010S BARIUM	15 J	81 J	298	156	102	11 J	249	46.6 J	11.8 J	119 J	101 J	56.4 J	122 J
6010S BERYLLIUM	0.77 J	1.1 J	2	0.43	0.74	0.54	0.55	0.69 J	0.67 J	0.52 J	1.3	0.79 J	1.6
6010S CADMIUM	0.23 U	3.1	0.175 U	0.125 U	4.3	0.15 U	0.28 J	0.12 U	0.53	0.65	6.9	4.5	5.7
6010S CALCIUM	1580 J	1650 J	NA	NA	NA	NA	NA	NA	1110 J	2330 J	1800 J	1530 J	2140 J
6010S CHROMIUM	5.2 J	264 J	18.3	16.9	171	11	13.1	20	5.1 J	16.3 J	357 J	172 J	240 J
6010S COBALT	2.8	4.1	NA	NA	4.2 J	NA	2.7 J	NA	3	3.7	5.4	4.7	5.8
6010S COPPER	3.9	1960	42.9	17.8	124	9.4	13.9	11.6	2.9	18.6	352	128	215
6010S IRON	9030	17000	NA	NA	NA	NA	NA	NA	8990	12900	13600 J	9660	16000 J
6010S MAGNESIUM	1040	1490	NA	NA	NA	NA	NA	NA	949	1320	1670	1370	2060
6010S MANGANESE	227 J	181 J	NA	NA	NA	NA	NA	NA	189 J	210 J	210 J	167 J	228 J
6010S NICKEL	4.3	26	199	5.6	12.2	2.7 J	4	12.3	4.7	9.2	17.9 J	11.5	36 J
6010S POTASSIUM	350	718	NA	NA	NA	NA	NA	NA	331	630	716 J	597	1180 J
6010S SODIUM	142	159	NA	NA	NA	NA	NA	NA	135	137	49.5 U	152	65.5 U
6010S VANADIUM	44.15 U	7.7 U	NA	NA	11.1	NA	8.5	NA	3.95 U	6.4 U	16.2	7.2 U	18.2
6010S ZINC	25.65 U	2650	158	93.8	9190	112	141	44.4	288	51.5 U	13300 J	10800	8530 J
7041S ANTIMONY	0.3 U	1.4 J	0.1 U	0.19 U	1.5 U	0.19 U	0.48 U	0.2 U	0.325 U	0.31 U	0.88 J	1.4 J	R
7060S ARSENIC	8 J	14.8 J	NA	NA	3.2	NA	3.5	NA	8.2 J	10.2 J	8.2 J	15.3 J	12 J
7421S LEAD	4.8	158	NA	NA	113 J	NA	29.1 J	NA	5.2	30.9	116	160	173
747ZS MERCURY	0.0265 U	0.62	0.19	0.28	0.77	0.15 U	0.34	0.13	0.0265 U	0.13	0.42	0.5	0.94
9010S CYANIDE	0.24 U	4 J	1.2 U	1.2 U	1.35 U	1.15 U	1.1 U	1.3 U	0.24 U	0.235 U	9.4	2.8 U	7.5
SNZZS TIN	4.6 U	18.2 J	NA	NA	NA	NA	NA	NA	4.7 U	4.65 U	20.7	16 J	14.7

All results in mg/kg (ppm).
All undetected results listed at half detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.

TABLE 4-5..
CRANSTON SITE
WARWICK AREA
SHALLOW SOIL
INORGANIC DATA

AREA/SUB AREA	SWMU5/C2	SWMU5/C3	SWMU5/C4	SWMU5/D2	SWMU5/D3	SWMU5/E3	SWMU-5 - SUMMARY					SWMU6/A1	SWMU6/B1	SWMU6/Y5	SWMU6/Y5	SWMU-6 - SUMMARY			
SAMPLE ID	SF-S5-C2(D)*IB-2	SF-S5-C3(D)*IB-1	SF-S5-C4(D)*IB-2	SF-S5-D2(D)*IB-1	SF-S5-D3(D)*IB-1	SF-S5-E3(D)*IB-2						SF-S6-A1*IB-2	SF-S6-B1*IB-2	SF-S6*IB-1	SF-S6*IB-2				
SAMPLE DATE	3/19/91	11/15/90	3/19/91	11/15/90	11/15/90	3/19/91						3/12/91	3/12/91	11/14/90	3/12/91				
DEPTH RANGE (ft)	1.5 to 2	1.5 to 2	1.5 to 2	1.5 to 2	1.5 to 2	1.5 to 2	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected	.5 to 1	.5 to 1	.5 to 1	.5 to 1	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected
	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q						Result Q	Result Q	Result Q	Result Q				
6010S BARIUM	162 J	113 J	18.1 J	207 J	112 J	1270 J	19	171.100	171.100	1270	11	17.8	18.6	17.3 J	16.4	4	17.525	17.525	18.6
6010S BERYLLIUM	1 J	0.76	0.47 J	0.62	1.1	0.34 J	19	0.842	0.842	2	0.34	0.34	0.32	0.37	0.62	4	0.4125	0.413	0.62
6010S CADMIUM	6.8	1.4	0.22 U	1.8	5.3	1.2	13	3.266	2.288	6.9	0.28	0.15 U	0.225 U	0.57	2.3	2	1.435	0.811	2.3
6010S CALCIUM	2150 J	2320 J	1040 J	2480 J	1700 J	3730 J	13	1966.154	1966.154	3730	1040	690	772	583 J	872	4	729.25	729.250	872
6010S CHROMIUM	325 J	25.2 J	5.8 J	58.7 J	257 J	34.4 J	19	106.105	106.105	357	5.1	9.9 J	9.8 J	7.4 J	7.8 J	4	8.725	8.725	9.9
6010S COBALT	4.8	4.1	3.1	6.4	4.6	3.8	15	4.213	4.213	6.4	2.7	7.2	7.8	4.8	3.8	4	5.9	5.900	7.8
6010S COPPER	211	103	6.9	66	182	42.8	19	184.826	184.826	1960	2.9	17.7 J	14.7 J	20.3	12.8 J	4	16.375	16.375	20.3
6010S IRON	14300	10300 J	11100	14400 J	13900 J	13900	13	12698.462	12698.462	17000	8990	20000	17600	11700 J	11400	4	15175	15175.000	20000
6010S MAGNESIUM	1600	1160	1040	2480	1580	1540	13	1484.538	1484.538	2480	949	3080 J	2880 J	1620	1430 J	4	2252.5	2252.500	3080
6010S MANGANESE	288 J	173 J	162 J	233 J	165 J	200 J	13	202.538	202.538	288	162	246 J	273 J	209 J	191 J	4	229.75	229.750	273
6010S NICKEL	19.3	17.4 J	5	14 J	17.4 J	11.2	19	22.616	22.616	199	2.7	14.1	14.7	8.8 J	8.1	4	11.425	11.425	14.7
6010S POTASSIUM	739	443 J	411	1520 J	879 J	529	13	695.615	695.615	1520	331	341 J	364 J	398 J	529 J	4	408	408.000	529
6010S SODIUM	192	55 U	123	57 U	59.5 U	215	8	156.875	118.577	215	123	118	152	440 U	169	3	146.3333333	219.750	169
6010S VANADIUM	9.7 U	12.2	4.4 U	22	15.2	6.5 U	7	14.771	12.893	22	8.5	12.5	12.4	10.1	12.7	4	11.925	11.925	12.7
6010S ZINC	16100	2210 J	22.9 U	1830 J	8750 J	664	16	4678.825	3945.329	16100	44.4	56.7 J	111 J	850 J	2390 J	4	851.925	851.925	2390
7041S ANTIMONY	1.1 J	R	0.3 U	R	0.86 J	41.8 J	6	7.907	3.208	41.8	0.86	0.265 U	0.27 U	R	0.245 U	0		0.260	0
7060S ARSENIC	12.6 J	9.4 J	9.3 J	9 J	11 J	12.5 J	15	9.813	9.813	15.3	3.2	16.2	13.7	5.6 J	6.8	4	10.575	10.575	16.2
7421S LEAD	215	428	44.7	271	156	87.2	15	132.793	132.793	428	4.8	10.7 J	7 J	18.7	43.6 J	4	20	20.000	43.6
747ZS MERCURY	0.89	0.17	0.025 U	0.21	0.54	0.45	15	0.439	0.358	0.94	0.13	0.025 U	0.025 U	0.025 U	0.025 U	0		0.025	0
9010S CYANIDE	8.5 J	1.2	0.225 U	2.8	7.5	0.25 U	7	5.843	2.747	9.4	1.2	0.2 U	0.225 U	0.99	0.8	2	0.895	0.554	0.99
SNZZS TIN	18.2 J	5.5 U	4.4 U	3.75 U	5.95 U	37.8 J	6	20.933	12.242	37.8	14.7	3 U	4.15 U	4 U	4.4 U	0		3.888	0

All results in mg/kg (ppm).

All undetected results listed a
half detection limit.

U - Undetected.

J - Estimated result.

R - Rejected result.

NA - Not analyzed.

TABLE 4-
CRANSTON SITE
WARWICK AREA
SHALLOW SOIL
INORGANIC DATA

AREA/SUB AREA		SWMU9/B2B	SWMU9/C1	SWMU9/C1	SWMU9/C2	SWMU9/ZZ1	SWMU9/ZZ2	SWMU-9 - SUMMARY					AA0116/MW17S	AA0116/MW17S	SWMU-16 - SUMMARY				
SAMPLE ID		SF-S9-B2(S)*IB-1	SF-S9-C1(S)*IB-1	SF-S9-C1(S)*IB-2	SF-S9-C2(S)*IB-1	SF-S9-ZZ1(S)*IB-2	SF-S9-ZZ2(S)*IB-2						SS-MW-17S*IB-1	SS-MW-17S*IB-2					
SAMPLE DATE		11/15/90	11/15/90	3/12/91	11/15/90	3/12/91	3/12/91						12/5/90	3/13/91					
DEPTH RANGE (ft)	Minimum Detected	.5 to 1 Result Q	.5 to 1 Result Q	.5 to 1 Result Q	.5 to 1 Result Q	.5 to 1 Result Q	.5 to 1 Result Q	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected	.5 to 1 Result Q	.5 to 1 Result Q	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
6010S BARIUM	16.4	34.6 J	7.3 J	7.6	85.5 J	21.4	20.3	6	29.45	29.450	85.5	7.3	13.4	12	2	12.7	12.7	13.4	12
6010S BERYLLIUM	0.32	0.58	0.46	0.49	0.78	0.36	0.34	6	0.5016667	0.502	0.78	0.34	0.59	0.43	2	0.51	0.51	0.59	0.43
6010S CADMIUM	0.57	0.25 U	0.15 U	0.225 U	0.21 U	0.19 U	0.25 U	0		0.213			0.2 U	0.225 U	0		0.213		
6010S CALCIUM	583	1060 J	363 J	575	2170 J	1140	1320	6	1104.6667	1104.667	2170	363	786 J	756	2	771	771	786	756
6010S CHROMIUM	7.4	7.9 J	1.3 J	2.7 J	20.7 J	8.9 J	10.6 J	6	8.6833333	8.683	20.7	1.3	5.8	4 J	2	4.9	4.9	5.8	4
6010S COBALT	3.8	3.6	1.1	1	7.6	6.4	6.6	6	4.3833333	4.383	7.6	1	3.5	2.9	2	3.2	3.2	3.5	2.9
6010S COPPER	12.8	7.3	1.6 U	3.3 J	31.9	12.9 J	14.1 J	5	13.9	11.850	31.9	3.3	6.4	4.8 J	2	5.6	5.6	6.4	4.8
6010S IRON	11400	9900 J	4610 J	5430	14100 J	15600	15100	6	10790	10790.000	15600	4610	9430	8240	2	8840	8840	9430	8240
6010S MAGNESIUM	1430	1410	290	349 J	5360	2450 J	2490 J	6	2058.1667	2058.167	5360	290	1300 J	881	2	1090	1090	1300	881
6010S MANGANESE	191	204 J	83.4 J	119 J	416 J	318 J	292 J	6	238.73333	238.733	416	83.4	290 J	254 J	2	272	272	290	254
6010S NICKEL	8.1	5.8 J	1.6 U	1.8 U	13.9 J	11.2	12.4	4	10.825	7.783	13.9	5.8	2.7 U	4.5	1	4.5	3.6	4.5	4.5
6010S POTASSIUM	341	979 J	364 J	410 J	4630 J	446 J	494 J	6	1220.5	1220.500	4630	364	612 J	576 J	2	594	594	612	576
6010S SODIUM	118	550 U	330 U	142	45.25 U	172	217	3	177	242.708	217	142	58 U	196	1	196	127	196	196
6010S VANADIUM	10.1	10.5	1.7	3.1	15.9	14.5	19.6	6	10.883333	10.883	19.6	1.7	5.9	11.5	2	8.7	8.7	11.5	5.9
6010S ZINC	56.7	56.6 J	24.8 J	29.6 J	70.8 J	35.7 J	39.8 J	6	42.883333	42.883	70.8	24.8	44.3	28.3 J	2	36.3	36.3	44.3	28.3
7041S ANTIMONY	0	R	R	0.28 U	R	0.25 U	0.25 U	0		0.260			R	0.31 U	0		0.31	0	0
7060S ARSENIC	5.6	7.1 J	2.4 J	4.2	9.3 J	9.9	10.2	6	7.1833333	7.183	10.2	2.4	6.8 J	3.7	2	5.25	5.25	6.8	3.7
7421S LEAD	7	32.9	124	2.8 J	22.15 U	7.2 J	17 J	5	36.78	34.342	124	2.8	4.7 J	5.6 J	2	5.15	5.15	5.6	4.7
747ZS MERCURY	0	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0		0.025			0.025 U	0.025 U	0		0.025		
9010S CYANIDE	0.8	0.23 U	0.225 U	0.185 U	0.235 U	0.18 U	0.2 U	0		0.209			R	0.22 U	0		0.22		
SNZZS TIN	0	5 U	3 U	44.15 U	4.15 U	3.85 U	4.95 U	0		10.850			3.95 U	4.45 U	0		4.2		

All results in mg/kg (ppm).
All undetected results listed a
half detection limit.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.

TABLE 4-34
CRANSTON SITE
WARWICK AREA
DEEP SOIL
INORGANIC DATA

AREA/SUB AREA		SWMU5/B5A2	SWMU5/B5B2	SWMU5/B5C2	SWMU5/B5D2	SWMU5/B5E2	SWMU5/B5F2	SWMU-5 SUMMARY					SWMU9/B9B2	SWMU9/B9A3	SWMU9/B9A3	SWMU-9 SUMMARY					SWMU16/B16E2	SWMU16/B16E2	AAOI16/B16A	SWMU16/B16B3	SWMU-16 SUMMARY				
SAMPLE ID		B-5A2*II-1	B-5B2*II-1	B-5C2*II-1	B-5D2*II-1	B-5E2*II-1	B-5F2*II-1						B-9B2*II-1	B-9A3*II-1	B-DUP5*II-1						B-16E2*II-1	B-DUP1*II-1	B-16A*IB-2	B-16B3*II-1					
SAMPLE DATE		7/28/93	7/28/93	7/28/93	7/28/93	7/28/93	7/29/93						7/27/93	7/27/93	7/27/93						7/21/93	7/21/93	3/13/91	7/21/93					
DEPTH RANGE (ft)		2 to 4	2 to 4	2 to 4	2 to 4	2 to 4	2 to 4	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected	2 to 4	4 to 6	4 to 6	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected	2 to 4	2 to 4	4 to 6	4 to 6	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
		Result Q	Result Q	Result Q	Result Q	Result Q	Result Q						Result Q	Result Q	Result Q						Result Q	Result Q	Result Q	Result Q					
6010S	BARIUM	48	104	149	9.9 J	11.8 J	28.1 J	6	58.5	58.5	149	9.9	12.8 J	17.7 J	17.6 J	3	16	16	17.7	12.8	15.2 J	10.1 J	11.2	13.3 J	4	12.5	12.5	15.2	10.1
6010S	BERYLLIUM	0.59	0.47	1.5	0.88	0.5 J	0.05 U	5	0.788	0.665	1.5	0.47	0.66 J	0.23 J	0.47 J	3	0.453	0.453	0.66	0.23	0.86	0.72	0.52	0.62	4	0.68	0.68	0.86	0.52
6010S	CADMIUM	0.145 U	2	7.6	0.13 U	0.255 U	0.15 U	2	4.8	1.71	7.6	2	NA	NA	NA	0					NA	NA	0.25 U	NA	0		0.25		
6010S	CALCIUM	NA	NA	NA	NA	NA	NA	0					NA	NA	NA	0					NA	NA	579	NA	1	579	579	579	579
6010S	CHROMIUM	10.3	49	478	5.3	3.4	7.6	6	92.3	92.3	478	3.4	5.9	6.1	6.2	3	6.07	6.07	6.2	5.9	4	2.6	5.9 J	2.5	4	3.75	3.75	5.9	2.5
6010S	COBALT	NA	NA	NA	NA	NA	NA	0					2.4 J	2.7 J	2.2 J	3	2.43	2.43	2.7	2.2	3.6 J	2.4 J	7.7	2.7 J	4	4.1	4.1	7.7	2.4
6010S	COPPER	11.3	45.5	356	3.4	1.8 J	8.1	6	71	71	356	1.8	4.6 J	24.9 J	6.6 J	3	12	12	24.9	4.6	6	3.5	5.5 J	6.1	4	5.28	5.28	6.1	3.5
6010S	IRON	NA	NA	NA	NA	NA	NA	0					NA	NA	NA	0					NA	NA	9400	NA	1	9400	9400	9400	9400
6010S	MAGNESIUM	NA	NA	NA	NA	NA	NA	0					NA	NA	NA	0					NA	NA	1140	NA	1	1140	1140	1140	1140
6010S	MANGANESE	NA	NA	NA	NA	NA	NA	0					NA	NA	NA	0					NA	NA	403 J	NA	1	403	403	403	403
6010S	NICKEL	17.1	8.1	15	3.5 J	2.4 J	4.5	6	8.43	8.43	17.1	2.4	3.6 J	5.9	4.2 J	3	4.57	4.57	5.9	3.6	2.9 J	2.2 J	6.1	2.8 J	4	3.5	3.5	6.1	2.2
6010S	POTASSIUM	NA	NA	NA	NA	NA	NA	0					NA	NA	NA	0					NA	NA	459 J	NA	1	459	459	459	459
6010S	SODIUM	NA	NA	NA	NA	NA	NA	0					NA	NA	NA	0					NA	NA	181	NA	1	181	181	181	181
6010S	VANADIUM	NA	NA	NA	NA	NA	NA	0					6.3	7.4	6.5	3	6.73	6.73	7.4	6.3	6.1	4.1 J	8.5	3.6 J	4	5.58	5.58	8.5	3.6
6010S	ZINC	111	1510	7300	23.6	18.3	38.1	6	1500	1500	7300	18.3	27 J	82.5 J	37.5 J	3	49	49	82.5	27	28.9 J	19 J	65.4 J	66.9 J	4	45.1	45.1	66.9	19
7041S	ANTIMONY	0.09 U	0.24 U	2.3 J	0.065 U	0.08 U	0.1 U	1	2.3	0.479	2.3	2.3	NA	NA	NA	0					NA	NA	0.34 U	NA	0		0.34		
7060S	ARSENIC	NA	NA	NA	NA	NA	NA	0					1.3 J	2.5 J	1.2 J	3	1.67	1.67	2.5	1.2	1.3 J	1.3 J	7.3	0.55 J	4	2.61	2.61	7.3	0.55
7421S	LEAD	NA	NA	NA	NA	NA	NA	0					7.2 J	42.4 J	6.9 J	3	18.8	18.8	42.4	6.9	6.3 J	8.1 J	3.6 J	3.7 J	4	5.43	5.43	8.1	3.6
7472S	MERCURY	0.15	0.3	1.3	0.045 U	0.09	0.1	5	0.388	0.331	1.3	0.09	NA	NA	NA	0					NA	NA	0.025 U	NA	0		0.025		
9010S	CYANIDE	1.4 U	1.15 U	1.85 U	0.8 U	0.95 U	0.9 U	0		1.18			NA	NA	NA	0					1.1 U	1.3 U	1.7	0.7 U	1	1.7	1.2	1.7	1.7

All results in mg/kg (ppm).
All undetected results listed at half-detection limit.
U - Undetected.
J - Estimated result.
NA - Not analyzed.

TABLE 4-35
CRANSTON SITE
WASTE WATER TREATMENT AREA
SURFACE WATER SAMPLES
ORGANIC DATA

AREA	WWTA	WWTA	SUMMARY				
SAMPLE ID	SW-01P*IB-1	SW-01P*IB-2	Frequency of Detection	Average Detected	Average Reported (with 1/2 detection limit)	Maximum Detected	Minimum Detected
COLLECT DATE	11/27/90	3/26/91					
	Result Q	Result Q					
VOLATILE ORGANICS							
KETONE/ALDEHYDES							
8240W 2-HEXANONE	5 U	7 J	1	7	6	7	7
ORGANOCHLORINE PESTICIDES							
8080W 4,4'-DDE	0.012	0.0049 U	1	0.012	0.00845	0.012	0.012
8080W ALDRIN	0.016	0.0049 U	1	0.016	0.0105	0.016	0.016
8080W KEPONE	0.0049 U	0.079	1	0.079	0.042	0.079	0.079

All units in ppb (ug/l).
All undetected results are listed at one-half of the reported detection.
U - Undetected.
J - Estimated result.

TABLE 4-36
CRANSTON SITE
WASTE WATER TREATMENT AREA
SURFACE WATER SAMPLES
INORGANIC DATA

TOTAL METALS

AREA	WWTA	WWTA	SUMMARY - TOTAL				
SAMPLE ID	SW-01P [T]	SW-01P*IB-2 [T]	Frequency of	Average	Average Reported	Maximum	Minimum
COLLECT DATE	11/27/90	3/26/91	Detection	Detected	(with 1/2 detection limit)	Detected	Detected
	Result Q	Result Q					
6010W BARIUM	37	30	2	33.5	33.5	37	30
6010W CALCIUM	15700	12300	2	14000	14000	15700	12300
6010W IRON	1800	850	2	1330	1330	1800	850
6010W MAGNESIUM	2000	1650	2	1830	1830	2000	1650
6010W MANGANESE	47	49	2	48	48	49	47
6010W POTASSIUM	4200 J	1500 U	1	4200	2850	4200	4200
6010W SODIUM	28300	16800	2	22600	22600	28300	16800
6010W ZINC	65	48	2	56.5	56.5	65	48
7421W LEAD	29	7.9 J	2	18.5	18.5	29	7.9

DISSOLVED METALS

AREA	WWTA	WWTA	SUMMARY - DISSOLVED				
SAMPLE ID	SW-01P [D]	SW-01P*IB-2 [D]	Frequency of	Average	Average Reported	Maximum	Minimum
COLLECT DATE	11/27/90	3/26/91	Detection	Detected	(with 1/2 detection limit)	Detected	Detected
	Result Q	Result Q					
6010W BARIUM	73	23	2	48	48	73	23
6010W CALCIUM	14900	11600	2	13300	13300	14900	11600
6010W IRON	220	157	2	189	189	220	157
6010W MAGNESIUM	1920	1470	2	1700	1700	1920	1470
6010W MANGANESE	22	22	2	22	22	22	22
6010W POTASSIUM	4430 J	1500 U	1	4430	2970	4430	4430
6010W SODIUM	27700	16100	2	21900	21900	27700	16100
6010W ZINC	46	33	2	39.5	39.5	46	33
7421W LEAD	6.4	1.5 U	1	6.4	3.95	6.4	6.4

All results in ppb (ug/l).
All undetected results are listed at one-half of the reported detection limit.
[T] - unfiltered sample (total).
[D] - filtered sample (dissolved).
U - Undetected.
J - Estimated result.

TABLE 4-37
CRANSTON SITE
WASTE WATER TREATMENT AREA
SEDIMENT SAMPLES
ORGANIC DATA

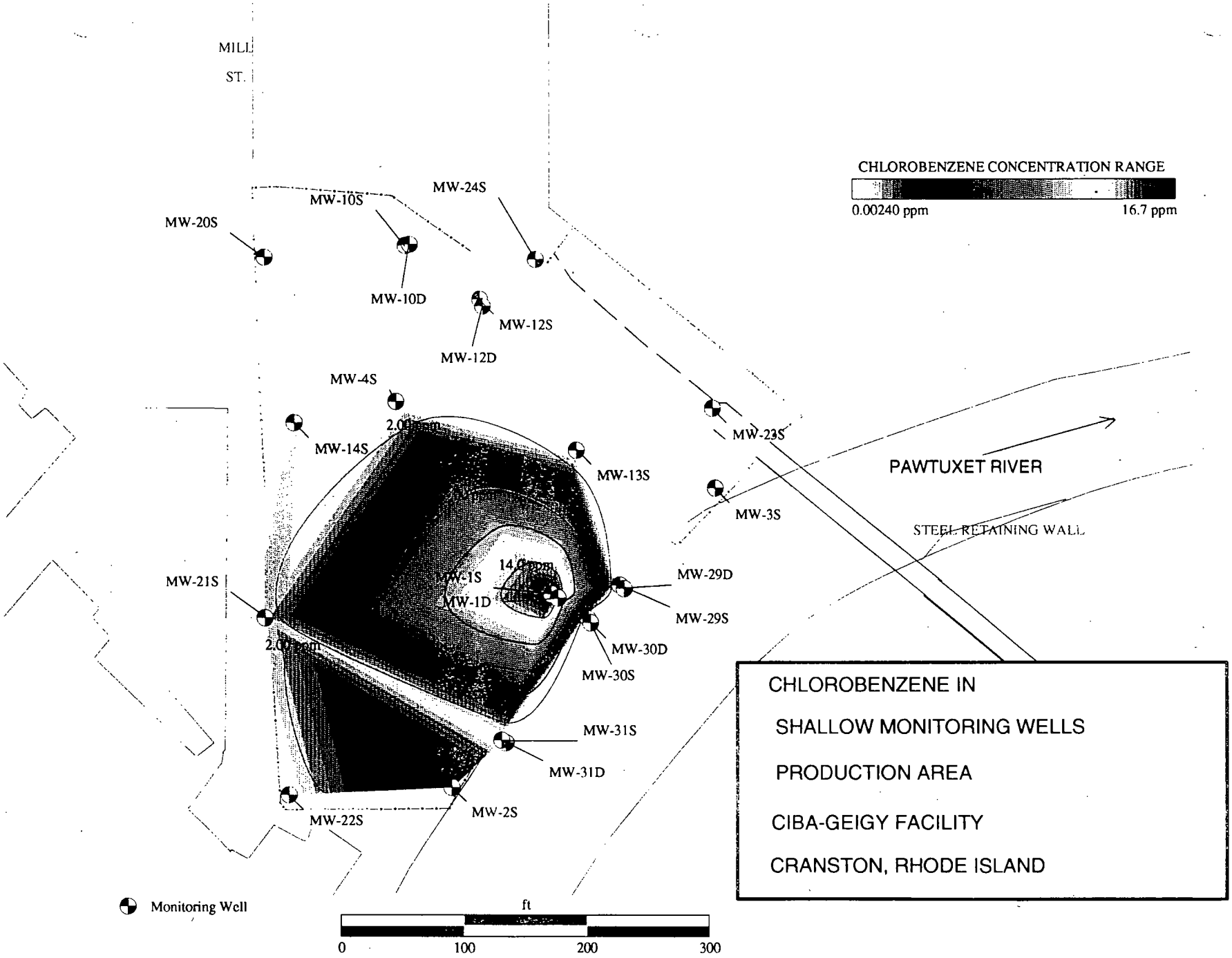
AREA	WWTA	WWTA	WWTA	WWTA	WWTA	SUMMARY				
SAMPLE ID	SD-01P*IB-1	SD-01P*IB-2	SD-02P*IB-1	SD-10P3*II-1	SD-10P4*II-1					
COLLECT DATE	11/29/90	3/29/91	11/29/90	8/11/93	8/11/93	Frequency		Average		
DEPTH RANGE (FT)	0 TO 0.5	0 TO 0.5	0 TO 0.5	0 TO 0.5	0 TO 0.5	of	Average	Reported	Maximum	Minimum
	Result Q	Result Q	Result Q	Result Q	Result Q	Detection	Detected	(with 1/2 detection limit)	Detected	Detected
VOLATILE ORGANICS										
HALOGENATED										
8240S CHLOROBENZENE	0.075 U	0.12 J	0.08 U	0.00425 U	U	1	0.12	0.0565	0 12	0.12
AROMATICS										
8240S M&P-XYLENE	0.075 U	0.095 U	0.08 U	0.00325 U	0.01 J	1	0.01	0.0527	0.01	0 01
8240S TOLUENE	0.075 U	0.24	0.08 U	0.00325 U	0.00425 U	1	0.24	0.0805	0.24	0.24
KETTONE/ALDEHYDES										
8240S ACETONE	0.155 U	0.185 U	0.16 U	0.016 U	0.19	1	0.19	0.141	0.19	0.19
SEMI-VOLATILE ORGANICS										
BASE NEUTRALS										
PAHs										
8270S 2-METHYLNAPHTHALENE	0.75 U	0.9 U	0.75 U	0 215 U	0.28 J	1	0.28	0.579	0.28	0.28
8270S ACENAPHTHENE	0.75 U	0.9 U	0.75 U	0.215 U	1	1	1	0.723	1	1
8270S ANTHRACENE	0.75 U	0.9 U	0.75 U	0.215 U	1.8	1	1.8	0.883	1.8	1.8
8270S BENZO(A)ANTHRACENE	0.18 J	0.16 J	0.75 U	0.15 U	3.2	3	1.18	0.888	3.2	0.16
8270S BENBO(A)PYRENE	0.75 U	0.14 J	0.75 U	0.059 J	2.8	3	1	0.9	2.8	0.059
8270S BENZO(B)FLUORANTHENE	0.32 J	0 25 J	0.46 J	0.083 J	3.4	5	0.903	0.903	3.4	0.083
8270S BENZO(G,H,I)PERYLENE	0.75 U	0.9 U	0.75 U	0.215 U	1.3 J	1	1.3	0.783	1.3	1.3
8270S BENZO(K)FLUORANTHENE	0.34 J	0.28 J	0.48 J	0.15 U	1.3	4	0.6	0.51	1.3	0.28
8270S CHRYSENE	0.22 J	0.24 J	0.25 J	0.084 J	3.5	5	0.859	0.859	3.5	0.084
8270S DIBENZ(A,H)ANTHRACENE	0.75 U	0.9 U	0.75 U	0.13 U	0.46 J	1	0.46	0.598	0.46	0.46
8270S FLUORANTHENE	0.34 J	0.53 J	0.41 J	0.12 J	5.6	5	1.4	1.4	5.6	0.12
8270S INDENO(1,2,3-CD)PYRENE	0.75 U	0.16 J	0.75 U	0.13 U	1.6 J	2	0 88	0.678	1.6	0.16
8270S NAPHTHALENE	0.75 U	0.9 U	0.75 U	0.215 U	0.82	1	0 82	0.687	0.82	0.82
8270S PHENANTHRENE	0.2 J	0.2 J	0.23 J	0.048 J	5.2	5	1.18	1.18	5.2	0.048
8270S PYRENE	0.41 J	0.25 J	0.5 J	0 114 J	5.5	5	1.35	1.35	5.5	0.114
PHTHALATES										
8270S BIS(2-ETHYLHEXYL)PHTHALATE	1.1 J	0.9 U	0.78 J	0.48	0.57	4	0.733	0.766	1.1	0.48
8270S BUTYLBENZYLPHTHALATE	0.75 U	0.9 U	0.75 U	0.215 U	0.15 J	1	0.15	0.553	0.15	0.15
HALOGENATED										
8270S 4-CHLOROPHENYL-PHENYLETHER	0.75 U	0.28 J	0.19 J	0.215 U	0.28 U	2	0.235	0.343	0.28	0.19
OTHER BASE NEUTRALS										
8270S DIBENZOFURAN	0.75 U	0.9 U	0.75 U	0.215 U	0.56 J	1	0.56	0.635	0.56	0.56
FINGERPRINT COMPOUNDS										
8270S TINUVIN 327	0.23 J	4.5 U	0.51 J	NA	NA	2	0.37	1.75	0.51	0.23
8270S TINUVIN 328	NA	NA	NA	2.8	7.3	2	5 05	5.05	7.3	2.8
ORGANOCHLORINE PESTICIDES										
8080S 4,4'-DDD	0.014 J	0.013 J	0.0075 U	0.00215 U	0.0072	3	0.0114	0.00877	0.014	0.0072
8080S 4,4'-DDE	0.0075 U	0.022 J	0.0075 U	0.00215 U	0.011	2	0 0165	0.01	0.022	0.011
8080S 4,4'-DDT	0.015 U	0.0097 J	0.015 U	0.00215 U	0.0028 U	1	0.0097	0.00893	0.0097	0.0097
8080S ALPHA-CHLORDANE	0.0075 U	0.0009 U	0.0075 U	0.0011 U	0.0045 J	1	0.0045	0.0043	0.0045	0.0045
8080S ENDRIN	0.0075 U	0.002	0.0075 U	0.00215 U	0.007 J	2	0.0045	0.00523	0.007	0.002
8080S GAMMA-CHLORDANE	0.0075 U	0.0009 U	0.0075 U	0.0034 J	0.017 J	2	0.0102	0.00726	0.017	0.0034
8080S KEPONE	0.0075 U	0.057 J	0.0075 U	0.011 U	0.0145 U	1	0.057	0.0195	0.057	0.057
CHLORINATED DIOXINS AND FURANS										
8270S DCDF	0.4 J	3 J	2.2 J	0 U	0 U	3	1.87	1.12	3	0.4
8270S TRCDF	1.4 J	5	5.8	0 U	0 U	3	4.07	2.44	5 8	1.4
SOWZS 2,3,7,8-TCDF	NA	NA	NA	0.000022 F	0.000046 F	2	0.000034	0.000034	0.000046	0.000022
SOWZS OCDD	NA	NA	NA	0.00021 J	0.00025 J	2	0.00023	0.00023	0.00025	0.00021
SOWZS TCDF	R	R	R	0.00026 J	0.00042 J	2	0.00034	0.00034	0.00042	0.00026

All units in ppm (mg/kg).
All undetected results are listed at one-half of the reported detection.
U - Undetected.
J - Estimated result.
R - Rejected result.
NA - Not analyzed.
F - Estimated maximum concentration.

TABLE 4-38
CRANSTON SITE
WASTE WATER TREATMENT AREA
SEDIMENT SAMPLES
INORGANIC DATA

SAMPLE ID	WWTA	WWTA	WWTA	WWTA	WWTA	SUMMARY				
DUPLICATE ID	SD-01P*IB-1	SD-01P*IB-2	SD-02P*IB-1	SD-10P3*II-1	SD-10P4*II-1					
COLLECT DATE	11/29/90	3/29/91	11/29/90	8/11/93	8/11/93	**Frequency of Detection**	**Average Detected**	**Average Reported (with 1/2 detection limit)**	**Maximum Detected**	**Minimum Detected**
Depth Range (ft)	0 to 0.5	0 to 0.5	0 to 0.5	0 to 0.5	0 to 0.5					
	Result Q	Result Q	Result Q	Result Q	Result Q					
METALS										
6010S BARIUM	28 J	41.6 J	23 J	19.7 J	43 J	5	31.1	31.1	43	19.7
6010S BERYLLIUM	0.53	0.5 J	0.37	0.23 J	0.8 J	5	0.486	0.486	0.8	0.23
6010S CADMIUM	0.265 U	0.57 J	0.275 U	NA	NA	1	0.57	0.37	0.57	0.57
6010S CALCIUM	1550 J	3040 J	1130 J	NA	NA	3	1910	1910	3040	1130
6010S CHROMIUM	8.9 J	8 J	6.5 J	5.3	11.1	5	7.96	7.96	11.1	5.3
6010S COBALT	3.2 J	3.3	2.5 J	2.8 J	5.3 J	5	3.42	3.42	5.3	2.5
6010S COPPER	15.9 J	19.2 J	13.7 J	11.1	32.1	5	18.4	18.4	32.1	11.1
6010S IRON	8000	7650	6370	NA	NA	3	7340	7340	8000	6370
6010S MAGNESIUM	1090 J	975	906 J	NA	NA	3	990	990	1090	906
6010S MANGANESE	94.3 J	176	72.2 J	NA	NA	3	114	114	176	72.2
6010S NICKEL	3.4 U	6.7 J	4.7 U	5.5	10.6	3	7.6	6.18	10.6	5.5
6010S POTASSIUM	441	400	360	NA	NA	3	400	400	441	360
6010S SODIUM	56.5 U	266	63 U	NA	NA	1	266	129	266	266
6010S VANADIUM	11.9	10.7	8.8	7.1	15.2	5	10.7	10.7	15.2	7.1
6010S ZINC	142 J	236 J	161 J	56.3	192	5	157	157	236	56.3
7060S ARSENIC	5.9 J	10.7	4.3 J	2 J	4.9 J	5	5.56	5.56	10.7	2
7421S LEAD	50.5	103 J	32.8	23.4 J	83.6 J	5	58.7	58.7	103	23.4
7740S SELENIUM	0.305 U	0.506	0.305 U	0.095 U	0.34 U	1	0.506	0.31	0.506	0.506
7841S THALLIUM	0.305 U	0.506	0.305 U	0.045 U	0.08 U	1	0.506	0.248	0.506	0.506

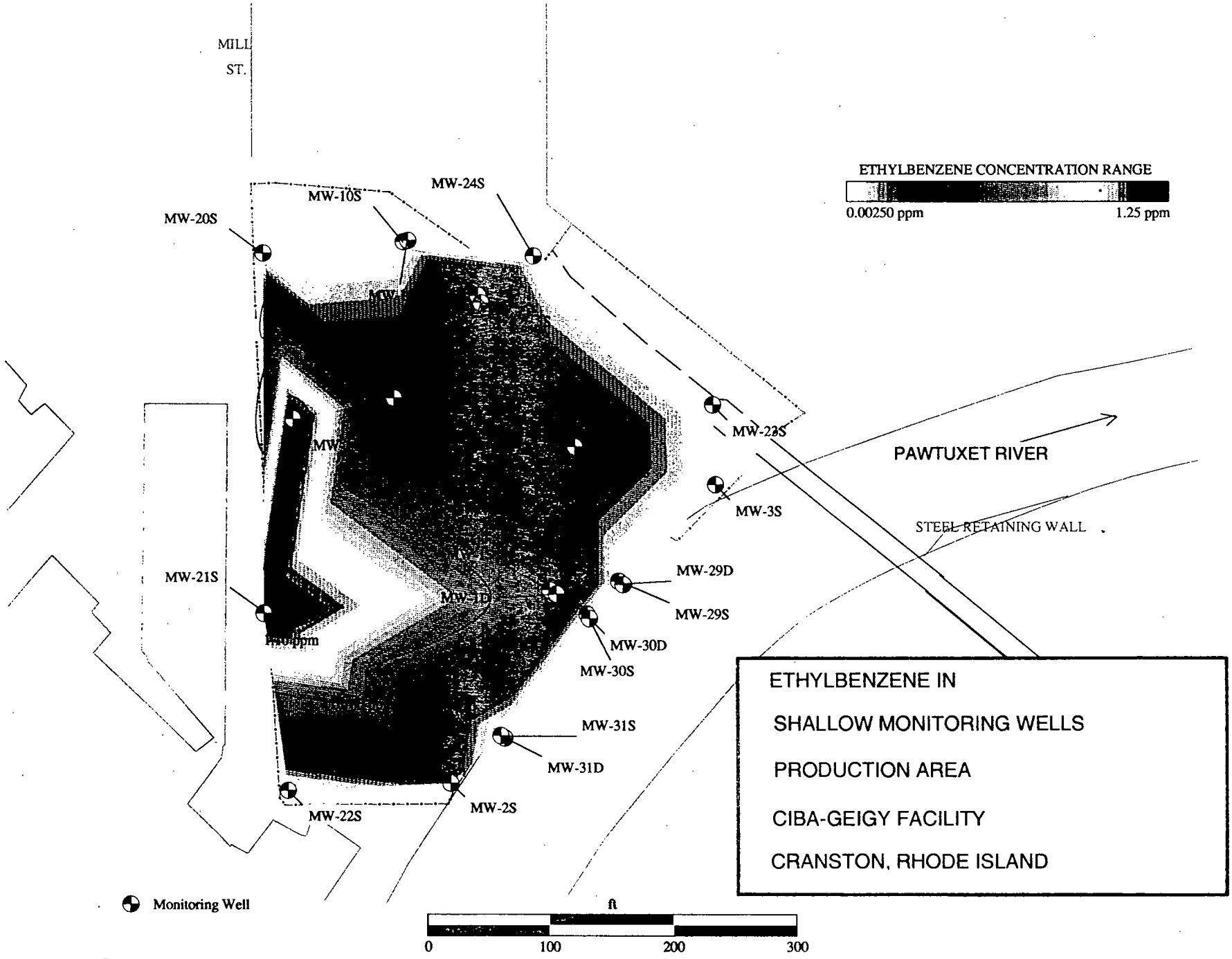
All units in ppm (mk/kg).
All undetected results are listed at one-half of the reported detection.
U - Undetected.
J - Estimated result.



Concentrations were averaged for all co-located samples.

Half detection limit value was used for non-detected results.

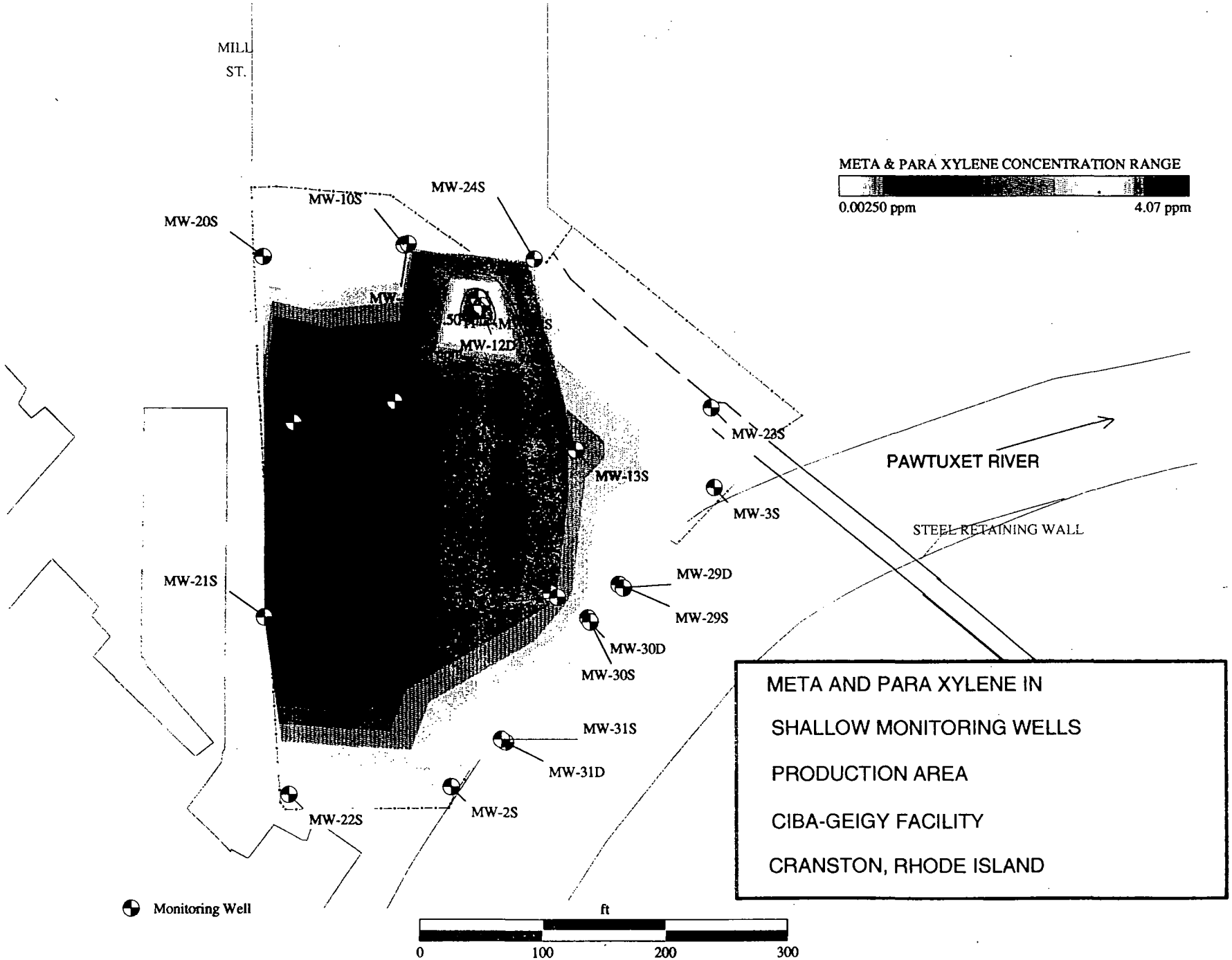
Figure No. 4–1



Concentrations were averaged for all co-located samples.

Half detection limit value was used for non-detected results.

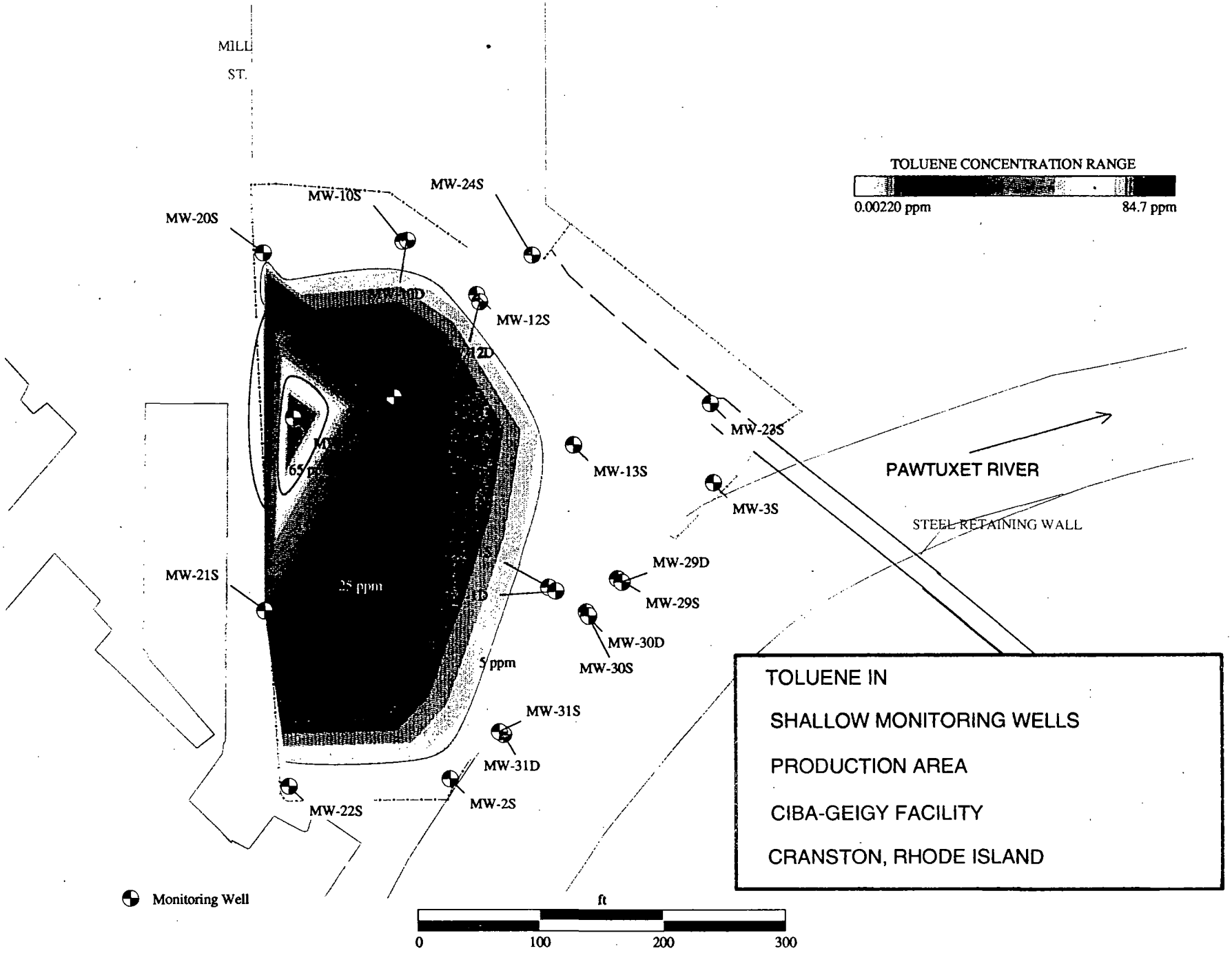
Figure No. 4–2



Concentrations were averaged for all co-located samples.

Half detection limit value was used for non-detected results.

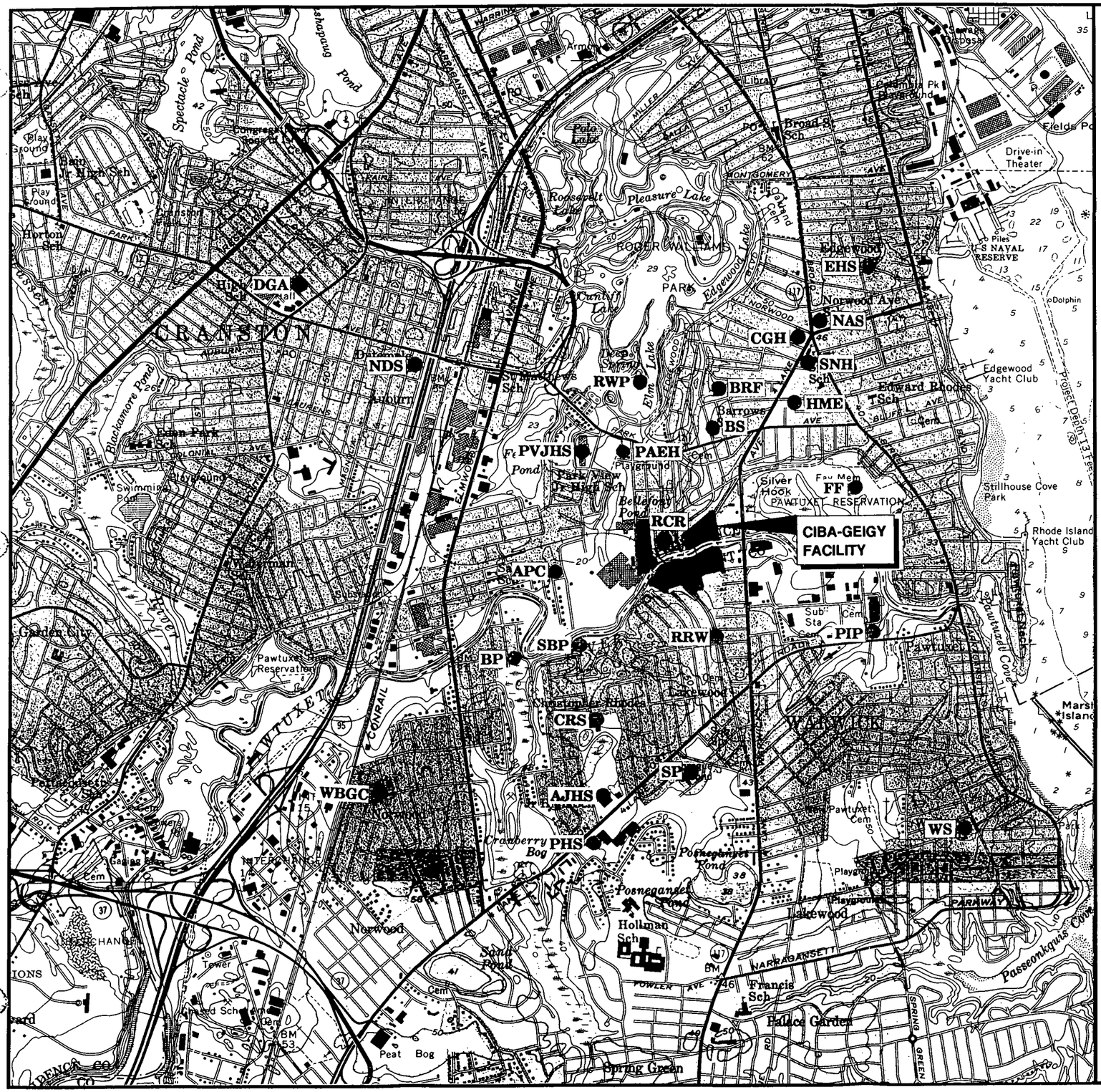
Figure No. 4–3



Concentrations were averaged for all co-located samples.

Half detection limit value was used for non-detected results.

Figure No. 4–4



Key	
Sample Abbreviation	Sample Location
AJHS	Aldrich Junior High School
APC	American Plating Company
BP	Belmont Park
BRF	Beechmont Recreational Field
BS	Beechmont Avenue Elementary School
CGH	Cranston General Hospital
CRS	Christopher Rhodes School
DGA	Dan Greenless' Aunt's House (by City Hall)
EHS	Edgewood High School
FF	Fay Memorial Field
HME	Hall Manor Elderly Housing
NAS	Norwood Avenue School
NDS	New Dutemple School
PAEH	Park Avenue Elderly Housing
PHS	Pilgrim High School
PIP	Pawtuxet Industrial Park
PVJHS	Park View Junior High School
RCR	Robert Circle Residence
RRW	Ciba-Geigy Railroad Right of Way
RWP	Roger Williams Park
SBP	South Bank of Pawtuxet River
SNH	Scandinavian Nursing Home
SP	Sprague Playground
WBGC	Warwick Boys and Girls Club
WS	Wyman School

LEGEND:

● SOIL SAMPLE LOCATION

MAP SOURCE:

U.S.G.S. 7.5 MINUTE SERIES QUADRANGLES OF EAST GREENWICH, RHODE ISLAND AND PROVIDENCE, RHODE ISLAND, DATED 1957, PHOTOREVISED 1970 AND 1975.

0 2000 4000 FT

SCALE

OFF-SITE/BACKGROUND SOIL SAMPLE LOCATIONS
CIBA-GEIGY FACILITY
CRANSTON, RHODE ISLAND

WOODWARD-CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
WAYNE, NEW JERSEY

DR. BY:	BAS	SCALE:	AS SHOWN	PROJ. NO.:	87X4660
CK'D. BY:	CLH	DATE:	MAY 15, 1995	FIG. NO:	4-5

R.I. STATE PLANE COORDINATE SYSTEM

SS-L1*II-1
B-2B
B-2E
B-2A
B-2D
SS-O7*II-1
SF-A13-O-10(S)
B-7B
SF-A13-Y-5(S)
SF-A13-T10(S)
SF-A13-T10(S)*IB*2
SF-A13-AA7(S)*IB-2
B-3D
SS-B2*II-1
B-2F
B-2C
B-2G
B-3E
B-3G
B-7E
B-7D
B-3H
B-3A
B-7A
SS-B7*II-1
SS-DUP-2*II-1
B-3
B-3B
B-3I
SF-A13010(S)*IB-2
SS-R12*II-1
SS-AE11*II-1
SS-J11*II-1
SS-N13*II-1
SS-K14*II-1
B-7F
B-7G
SS-W13*II-1
SS-AJ15*II-1
SS-DUP3*II-1
B-7C
B-3C
B-7H
SS-Y15*II-1
B-13AD15
SS-C16*II-1
B-13E16
B-13016
SS-S15*II-1
SS-U17*II-1
B-13A
SS-O17*II-1
B-8D
B-8A
B-8E
B-11A
B-11B
SS-L16*II-1
SS-T20*II-1
SS-Y21*II-1
B-8G
SS-AB21*II-1
B-11C
SS-J21*II-1
SF-AB-21*II-1
SS-C20*II-1
SS-Q22*II-1
B-8B
B-8C
SS-E23*II-1
SS-M22*II-1
B-8F
B-8H
SS-AA23*II-1
SS-AB24*II-1
SF-A13-A-25(S)
A13-025(S)
SS-V23*II-1
B-13026
SS-F26*II-1
SF-A13-Q27(S)*IB-2
SS-AF26*II-1
B-13Y26
SS-Z28*II-1
SF-A13-C27(S)*IB-2
SS-N29*II-1
SF-A13-J30(S)
SS-U28*II-1
SS-E31*II-1
SS-R31*II-1
S-K26*II-1
SF-A13-L32(S)*IB-2
SS-W32*II-1
SF-A13-J35(S)
SS-S34*II-1
SS-E35*II-1
SF-S-34*II-1
SS-N35*II-1
SS-U36*II-1
B-13F36
SF-V-36*II-1
B-13036
AA-DUP1*II-1
SS-D37*II-1
SF-A13-L37(S)*IB-2
SS-G38*II-1
SS-Q38*II-1
SF-A13-J40(S)
SF-A13-A40(S)
SS-M42*II-1
SF-M-42*II-1
SF-A13-C41(S)*IB-2
SS-Q42*II-1
SF-A13-J40(S)*IB-2
SF-O-43*II-1
SS-I43*II-1
SS-O44*II-1
SF-I-43*II-1
SF-P-44*II-1
SF-A13-E45(S)
SF-O-44*II-1
SS-45*II-1
SF-N-44*II-1
B-13F45
SF-J-45*II-1
SF-O-45*II-1
B-13045
SF-A13-G47(S)*IB-2
SS-L48*II-1
BRIDGE
BRIDGE

0 30 60 120
SCALE (FEET)

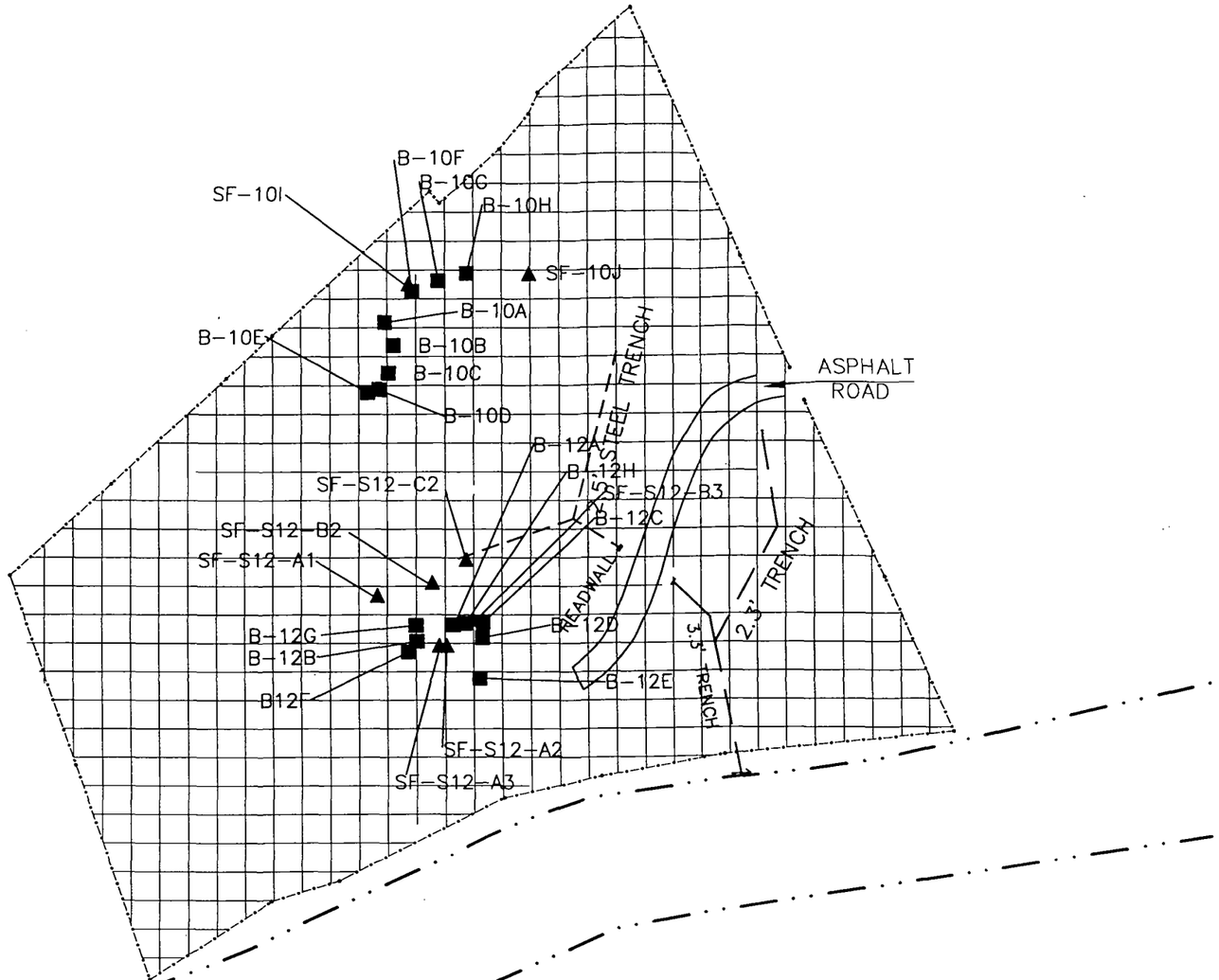
SOIL SAMPLING LOCATIONS PRODUCTION AREA
CIBA GEIGY
CRANSTON, RHODE ISLAND

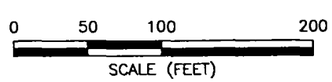
WOODWARD-CLYDE CONSULTANTS
ENGINEERING & SCIENCES APPLIED TO THE EARTH & ITS ENVIRONMENT
WAYNE, NEW JERSEY

DR. BY	DJB	SCALE	AS SHOWN	DWG. NO. 74660063	PROJ. NO. 87X4660
CK'D. BY	KAK	DATE	JULY 28, 1995	FIG. NO.	4-6A

File name: K:\CADD\87X4660\74660063.DWG Last edited: 95/07/28 @ 15:05

R.I. STATE PLANE COORDINATE SYSTEM





SOIL SAMPLING LOCATIONS WASTE WATER TREATMENT AREA
CIBA GEIGY
CRANSTON, RHODE ISLAND

WOODWARD-CLYDE CONSULTANTS

ENGINEERING & SCIENCES APPLIED TO THE EARTH & ITS ENVIRONMENT
WAYNE, NEW JERSEY

DR. BY	DJB	SCALE	AS SHOWN	DWG. NO. 74660064	PROJ. NO. 87X4660
CK'D. BY	KAK	DATE	JULY 28, 1995	FIG. NO.	4-6B

File name: K:\CADD\87X4660\74680065.DWG Last edited: 95/07/28 @ 15:12

OFFSITE AREA

R.I. STATE PLANE COORDINATE SYSTEM

PAWTUXET RIVER

B-5F
SF-S5-YY3
SF-S5-ZZ3
SF-S5-C1
B-5D
B-5H
SF-S5-C2
SF-S5-D2
B-5E
B-5C
SF-S5-A2
B-5B FORMER WOBURN AVENUE
SF-S5-E3
SF-S5-D3
B-5A
SF-S5-B3
SF-S5-C3
SF-S5-C4
B-5G

WARWICK AVENUE

VINE AVENUE

SF-S9-ZZ1
SF-S9-C1
SF-S9-ZZ2
SF-S6-A1
SF-S9-C2
SF-S9-B2
SF-S6-B1
B-22A
B-22B
SF-S6

WARWICK AREA

B-16E
B-16D
SS-MW-17S
B-16B
B-16C

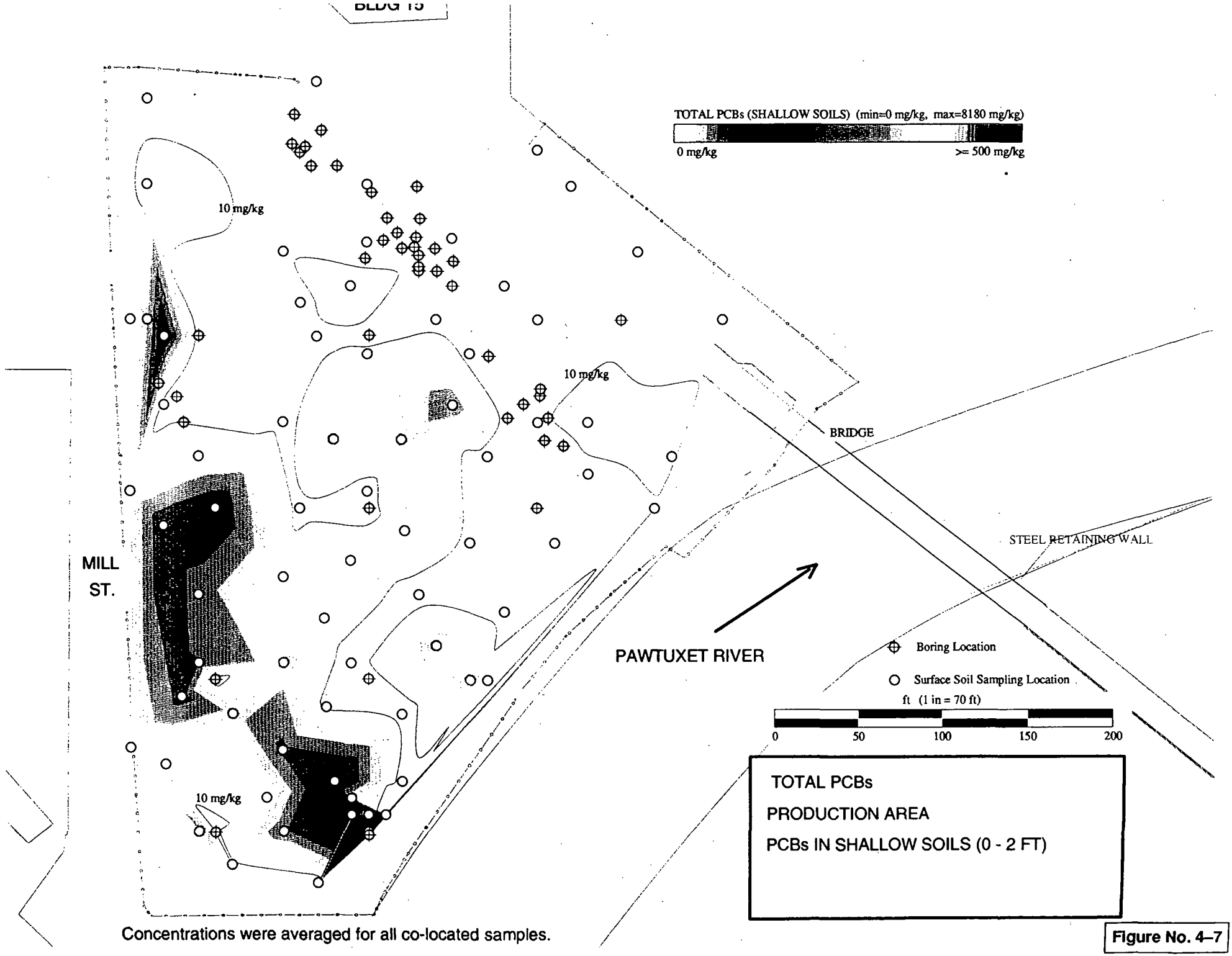
0 50 100 200
SCALE (FEET)

SOIL SAMPLING LOCATIONS WARICK AREA
CIBA GEIGY
CRANSTON, RHODE ISLAND

WOODWARD-CLYDE CONSULTANTS
ENGINEERING & SCIENCES APPLIED TO THE EARTH & ITS ENVIRONMENT
WAYNE, NEW JERSEY

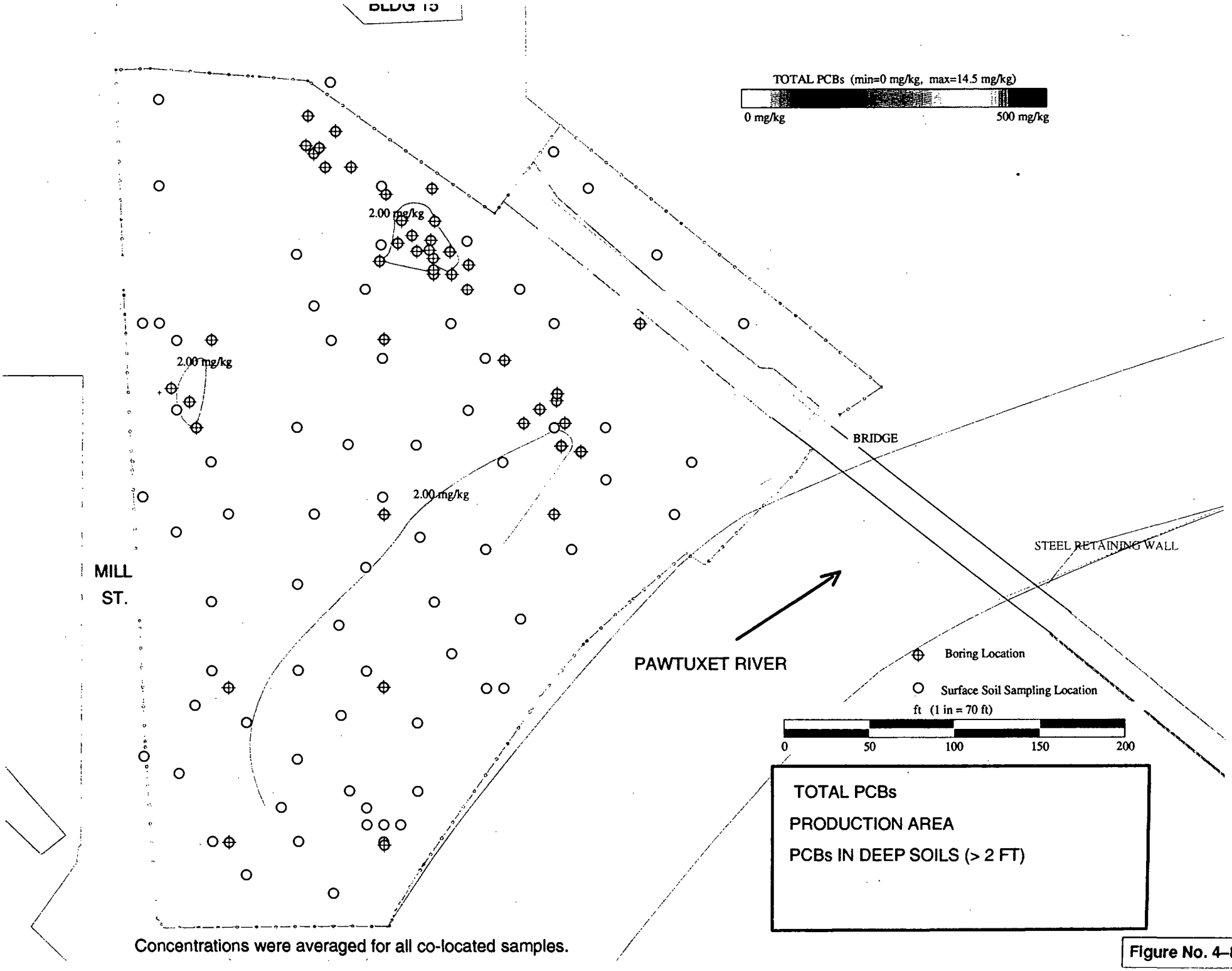
DR. BY	DJB	SCALE	AS SHOWN	DWG. NO. 74660064	PROJ. NO. 87X4660
CK'D. BY	KAK	DATE	JULY 28, 1995	FIG. NO.	4-6C

File name: K:\CADD\87X4660\74660064.DWG Last edited: 95/07/28 @ 15:21



Concentrations were averaged for all co-located samples.

Figure No. 4–7



Concentrations were averaged for all co-located samples.

Figure No. 4–8

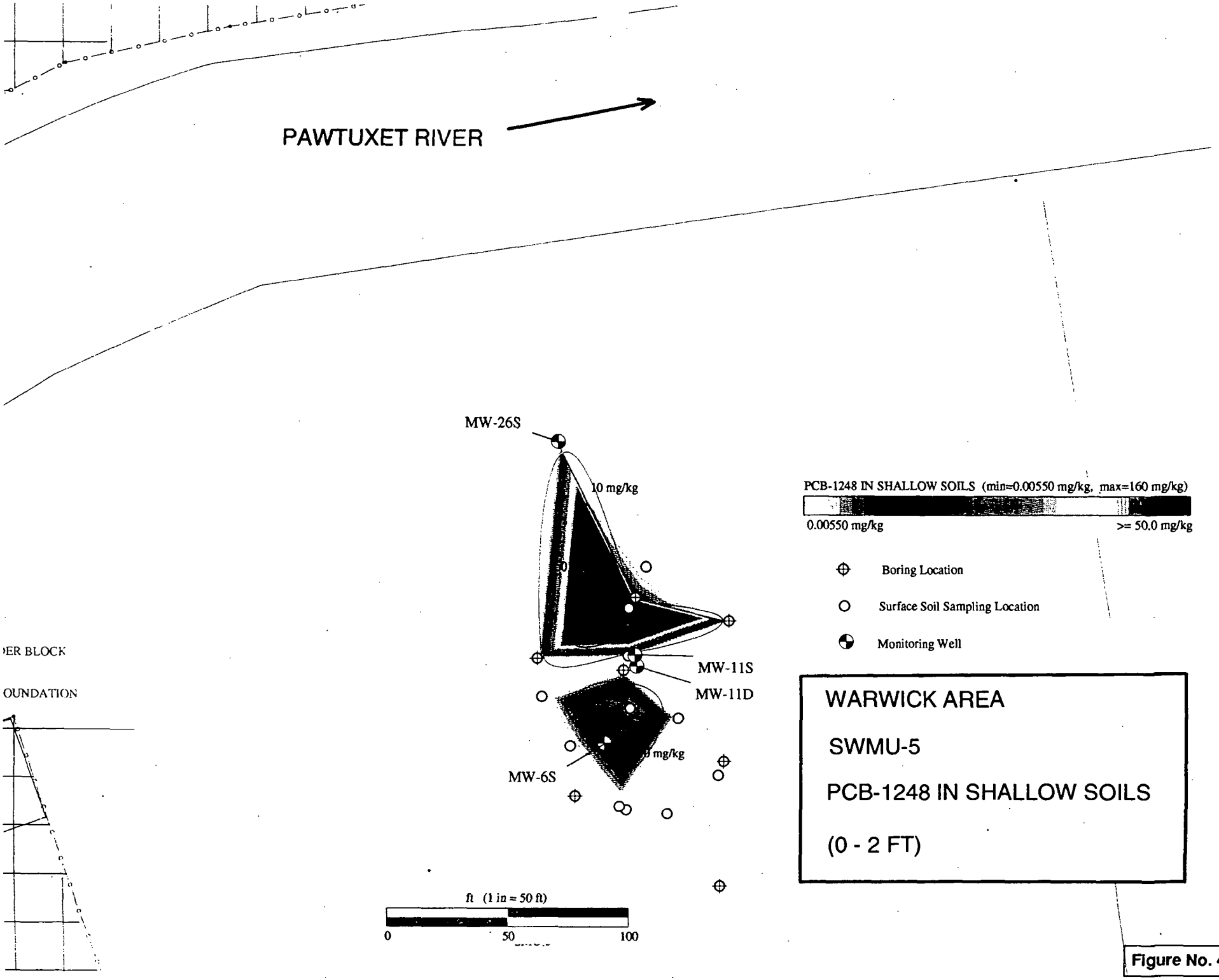
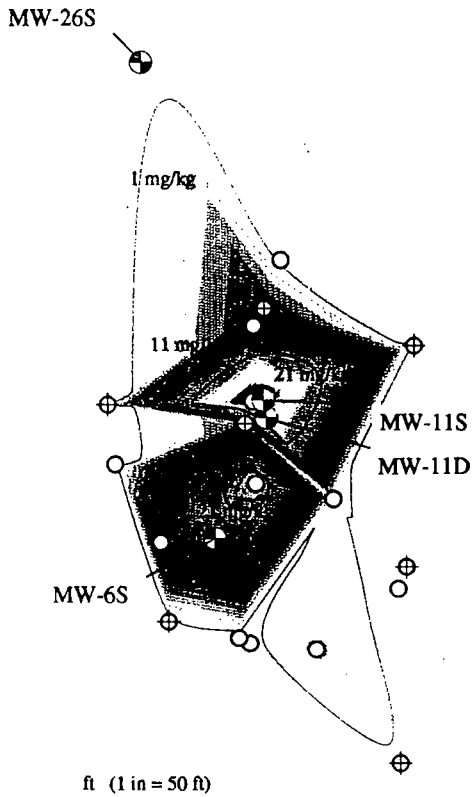

PAWTUXET RIVER
MW-26S
10 mg/kg
MW-11S
MW-11D
MW-6S
ft (1 in = 50 ft)
0
50
100
PCB-1248 IN SHALLOW SOILS (min=0.00550 mg/kg, max=160 mg/kg)
0.00550 mg/kg
>= 50.0 mg/kg
Boring Location
Surface Soil Sampling Location
Monitoring Well
WARWICK AREA
SWMU-5
PCB-1248 IN SHALLOW SOILS
(0 - 2 FT)

Figure No. 4–9

PAWTUXET RIVER



PCB-1254 IN SHALLOW SOILS

0.0115 mg/kg — 36.0 mg/kg

Boring Location

Surface Soil Sampling Location

Monitoring Well

K

ION

WARWICK AREA

SWMU-5

PCB-1254 IN SHALLOW SOILS

(0 - 2 FT)

Figure No. 4–10

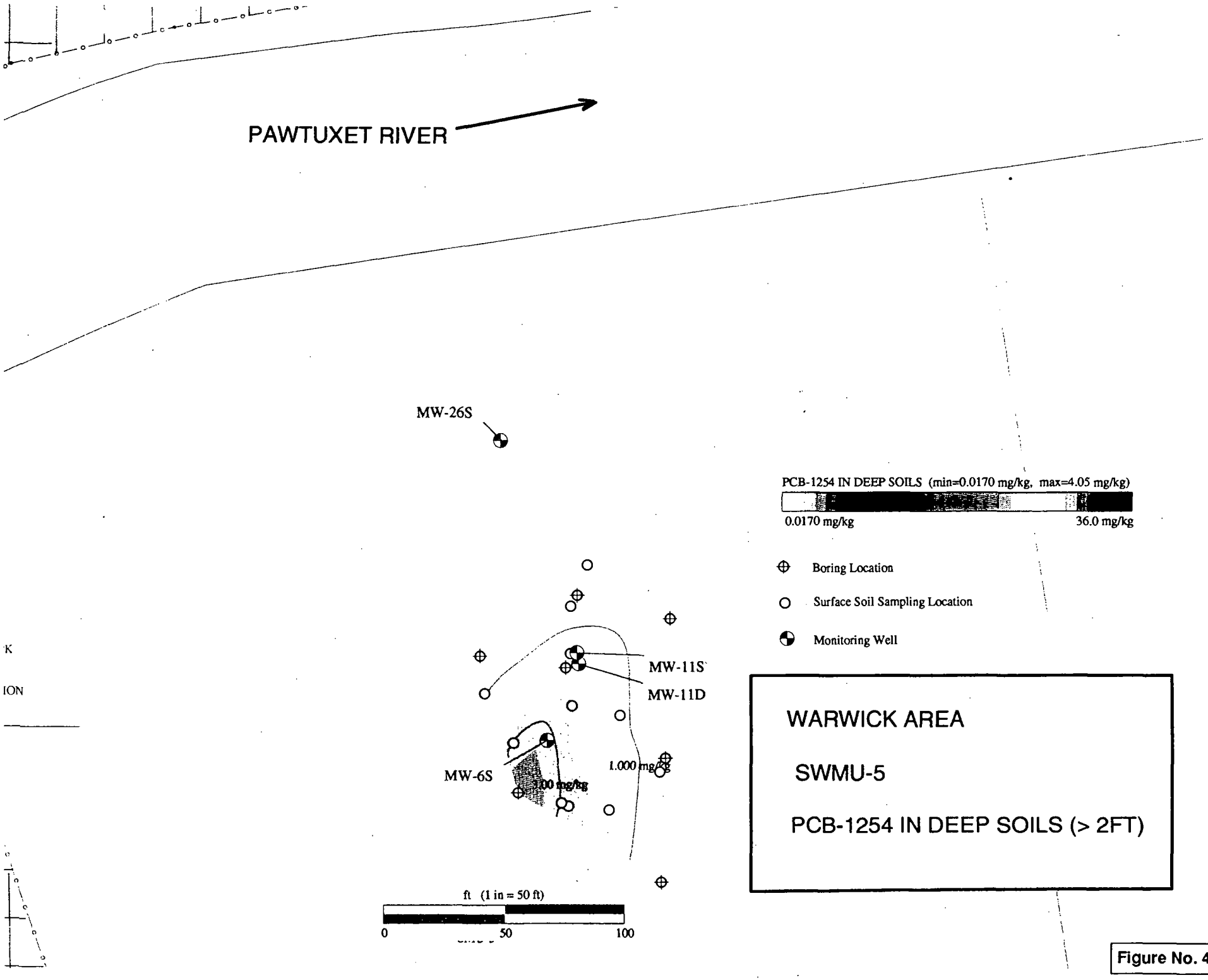


Figure No. 4–11

5.1 INTRODUCTION

This chapter discusses the expected transport and fate of chemicals detected at the Cranston Site (Site), based upon physical/chemical properties of the chemicals, and site geology and hydrogeology. Because transport of chemicals in groundwater is expected to be the primary migration pathway at the site, this section focuses on the tendency of chemicals to leach from soil to groundwater, and their subsequent mobility in groundwater. Potential losses of chemicals through volatilization and degradation are also discussed. Section 5.2 presents the behavior of chemicals of concern in soil and aqueous media based on groupings of chemicals with similar properties. Section 5.3 presents the site specific routes of migration for the Production Area, Waste Water Treatment Area, and Warwick Area based on the chemical groupings presented in Section 5.2.. Section 5.4 presents a summary of the degradation potential for chemicals present at the Cranston Site. Section 5.5 discusses the transport and fate process which occur as groundwater discharges to the Pawtuxet River and Section 5.6 presents the conclusions . A discussion of the overall theoretical processes which affect chemical fate, stability and transport is presented in Appendix 5-A. A listing of the chemical and physical properties for chemicals of concern which affect the fate and transport of these chemicals is presented in Table 5.1. A summary of the potential degradation modes and degradation products is presented in Table 5-2, and a summary of the transport properties of these chemicals is presented in Table 5-3.

5.2 BEHAVIOR OF ORGANIC COMPOUNDS IN SOIL AND AQUEOUS MEDIA

This section describes how the behavior of the chemicals of interest introduced to soil and groundwater at the Site based upon the properties of the chemicals, and the site setting. Chemicals from seven different chemical groups have been detected in one or more of the areas investigated. Those chemical groups include:

1) volatile organics
2) semi-volatile organics
3) polychlorinated biphenyls (PCBs)
4) organochlorine pesticides
5) organophosphorous pesticides
6) herbicides
7) dioxins/furans

Chemical property data presented in Table 5-1, chemical degradation information summarized in Tables 5-2 and transport properties summarized in Table 5-3 were evaluated to discern the potential for mobility and persistence of the groups of

chemicals of interest in soil and groundwater. Chemical property data used primarily in determining the potential mobility/volatility of chemicals in groundwater and soils included vapor pressure, Henry's Law constant, water solubility, partition coefficients, K_{oc} and K_{ow}, and molecular weight. A discussion of how these chemical properties affect the fate and transport of the chemicals of concern is presented in the following sections for each chemical group.

5.2.1 Volatile Organics

VOCs detected included carbon disulfide and halogenated and non-halogenated aromatics. Chlorobenzene was the principal chlorinated aromatic detected; ethylbenzene, toluene and xylenes were the non-halogenated aromatics detected most frequently. These VOCs tend to be moderately mobile in soil since they are not expected to adsorb strongly to soils based on log K_{oc} values. Additionally, these compounds are expected to volatilize appreciably from soils based on vapor pressure values. If leached to groundwater, volatiles are expected to be somewhat mobile based on their moderate hydrophobicity. Based on Henry's Law constants, loss of these compounds through volatilization may be significant in shallow groundwater; this process would be somewhat retarded by moderate adsorption to sediment.

Carbon disulfide will not readily biodegrade; however, it has the potential for degrading via photo-oxidation. Carbon disulfide can also form as a result of bacterial metabolism under reducing conditions. Carbon disulfide is highly volatile and oxidizes to carbonic acid and sulfate under oxidizing conditions in groundwater. Aromatic volatiles are susceptible to biodegradation with aerobic conditions favoring degradation. Ethylbenzene, toluene and xylenes aerobically biodegrade at a much faster rate than chlorobenzene. Chlorobenzene has a slow biodegradation rate. Loss of these compounds through photolysis, hydrolysis and oxidation are considered insignificant. Ethylbenzene and toluene are also susceptible to degradation by photo-oxidation.

5.2.2 Semi-Volatile Organics

With respect to SVOCs, dichlorobenzenes, trichlorobenzenes, PAHs, phthalates, phenol, substituted phenols, and 4-chloroaniline were detected frequently. Fingerprint SVOCs such as Irgasan DP-300, Propazine, and Tinuvan (327 or 328), as well as benzyl alcohol, dibenzofuran, trichlorodibenzofuran, and chlorinated dioxins and furans were also detected to a limited extent during the site investigations.

Of the later group of SVOCs, benzyl alcohol is expected to exhibit the highest potential for mobility in soil and groundwater. Benzyl alcohol is expected to be mobile in soil based on its aqueous solubility. Low log K_{ow} and log K_{oc} values indicate little tendency for benzyl alcohol to adsorb to soil. Benzyl alcohol is expected to exhibit low volatility from soil. Once benzyl alcohol has leached to the

water table, it is expected to be mobile in groundwater due to its solubility and low potential for sediment adsorption. Based on its Henry's Law constant, volatilization from groundwater is not expected to be a significant removal process. No available information exists on the degradation potential of benzyl alcohol; however, alcohols in general tend to be susceptible to aerobic biodegradation as well as hydrolysis.

4-Chloroaniline, methylphenols, and chlorophenols are somewhat hydrophobic and are therefore expected to exhibit moderate mobility in soils based on log K_{oc} values. The hydrophobicity of chlorophenols increases with the degree of chlorination. These compounds have some tendency to adsorb to soil and will likely not volatilize from soil. However, volatilization from surface soil may account for some loss based on reported vapor pressures. Once reaching groundwater, these compounds will exhibit moderate mobility and will not appreciably volatilize. Mobility in groundwater will be somewhat retarded by adsorption to soils. Phenol is likely to be more mobile in groundwater than the chlorophenols based on a lower log K_{ow} and log K_{oc}. In contrast, pentachlorophenol will tend to be immobile in soil and groundwater due to its strong hydrophobicity and affinity for soils. 4-Chloroaniline is susceptible to chemical and biological actions in soil. Phenol, chlorophenols and methylphenols are susceptible to aerobic biodegradation and potentially photolysis. None of these compounds are readily hydrolyzed.

Dichlorobenzenes have some tendency to adsorb to soil and sediments and therefore will exhibit moderate mobility in soil and groundwater. Based on vapor pressure values, dichlorobenzenes can be expected to volatilize from surface soils. Dichlorobenzenes can be moderately mobile in groundwater, exhibit volatility and have some tendency to adsorb to sediments. Trichlorobenzene, on the other hand, has extremely limited mobility in soils and groundwater due to its strong tendency for adsorption to soil and sediment; leaching to groundwater is therefore expected to be minimal. Based on its Henry's Law constant, trichlorobenzene has the potential to volatilize from shallow groundwater and surface soils; however, its strong tendency to adsorb to soil/sediment limits the potential for volatility from same. Degradation through hydrolysis, photolysis, oxidation and biodegradation are not expected to be significant sources of removal for dichlorobenzenes or trichlorobenzene.

Phthalates and PAH compounds such as dibenzo(a,h)anthracene and fluorene have limited to extremely limited mobility in soils due to strong tendencies to be adsorbed. In general, both groups of compounds would be expected to exhibit low volatility from soils. Phthalates and PAHs with the exception of naphthalene as discussed below have limited to extremely limited mobility in groundwater based on their hydrophobicity and strong tendency to adsorb to soil and sediment. In most cases, Henry's Law constants indicate that phthalates and PAHs are not susceptible to loss from groundwater via volatilization. Both phthalates and PAHs are susceptible to aerobic biodegradation and have limited potential for degradation through hydrolysis, photolysis or oxidation.

Little information is available to assess the potential for mobility for Irgasan DP-300. Based on its vapor pressure, this compound is not expected to volatilize significantly from groundwater or soil. Irgasan is expected to be hydrophobic to strongly hydrophobic based on its high molecular weight. Propazine is expected to exhibit moderate mobility in groundwater and soil based on its water solubility. No information is available to determine volatility characteristics or preference for adsorption to soil/sediment.

Tinuvin (327 or 328) has a strong tendency to adsorb to soils. Significant leaching to groundwater is therefore expected to be minimal. Based on low vapor pressure and a relatively high log K_{oc} value, Tinuvin (327 or 328) should not volatilize appreciably from soil. These compounds are also expected to be generally immobile in groundwater due to their affinity for soils, and estimated Henry's Law constants indicate that volatility from groundwater will not be significant. No information on the degradation potential of Tinuvin is available.

Two SVOCs detected at the Site which are moderately mobile are naphthalene and aniline. Naphthalene exhibits moderate mobility in groundwater with some tendency to adsorb to soils. Aniline has a high water solubility and therefore would tend to be mobile in groundwater. In general, naphthalene and aniline, like other PAHs, are potentially susceptible to aerobic degradation.

5.2.3 PCBs

PCBs detected at the Site are expected to exhibit a strong tendency to adsorb to soil/sediment, limiting their mobility in both soil and groundwater. Low vapor pressure substantially limits potential volatility from soils, and the strong affinity for soils/sediments limits PCB volatilization from groundwater. Loss through photolysis, hydrolysis, oxidation and biodegradation are not significant processes for PCBs in groundwater and soils.

5.2.4 Organochlorine Pesticides

Most traditional chemical pesticides can be divided into two groups consisting of organochlorine and organophosphorus pesticides. The organochlorine pesticides (such as methoxychlor) detected at the Site can be described as having limited to extremely limited mobility and volatility in groundwater and soil based on the available chemical data. The pesticides of interest are moderately to strongly hydrophobic and have a tendency to strongly adsorb to soil/sediment based on log K_{ow} and log K_{oc} values. These compounds, with the exception of gamma-chlordane, are expected to exhibit low volatility from groundwater and soil/sediment based on vapor pressure and Henry's Law constant. Gamma-chlordane in the dissolved phase is expected to exhibit some volatility from shallow groundwater based on its Henry's Law constant. Gamma-chlordane is, however, nearly insoluble in water.

Organochlorine pesticides generally do not biodegrade appreciably. Some biodegradation of these compounds has been reported under both aerobic and anaerobic conditions. Generally, degradation in groundwater and soil through hydrolysis, photolysis and oxidation is limited for organochlorine pesticides.

5.2.5 Organophosphorus Pesticides

Dimethoate is the only organophosphorus pesticide detected with any frequency at the Site. Due to its low affinity for soil/sediment and low volatility, dimethoate is expected to be very mobile in soil. Once dimethoate reaches the water table, it is expected to be mobile based on its solubility plus low tendency to adsorb to sediment. Based on its Henry's Law constant, volatilization from groundwater is expected to be negligible. Dimethoate may be susceptible to hydrolysis in soils and groundwater, especially under alkaline conditions. Photolysis and evaporation from groundwater are not considered important processes. Dimethoate is expected to slowly biodegrade in groundwater and soil under both aerobic and anaerobic conditions; however, aerobic conditions favor higher degradation rates.

5.2.6 Herbicides

Herbicide compounds of interest (primarily dinoseb) are expected to be moderately mobile in soil based on their hydrophobic nature. The potential to leach to groundwater increases in coarse-grained sandy soils with low organic content. Major losses of herbicides in soil can be directly related to aerobic biodegradation and photolysis in surface soils. Herbicides are expected to exhibit little volatility from soils. Dissolved in groundwater, herbicides are expected to be moderately mobile and will tend to adsorb to sediments where they will biodegrade. Dissolved herbicides also tend to biodegrade in groundwater, however, the biodegradation rate of herbicides is compound specific and highly variable and complicated by the production of daughter products. Loss of herbicides is expected to be insignificant from groundwater through volatilization.

5.2.7 Dioxins/Furans

Dibenzofuran, trichlorodibenzofuran and chlorinated dioxins have strong tendencies to adsorb to soil based on log K_{oc} values and are therefore expected to be relatively immobile in soil. Additionally, low vapor pressure and strong affinity for soils limits losses of these compounds through volatilization. If leached to groundwater, these compounds will adsorb to the soil, thereby limiting the mobility of these compounds in groundwater. If dissolved in water, furans and chlorinated dioxins have the potential to volatilize from shallow groundwater based on available Henry's Law constants. However, this process is not expected to be significant due to the low solubility of these compounds. Loss from photolysis, hydrolysis, oxidation and

biodegradation are expected to be insignificant for these compounds with the exception of dibenzofuran, which may aerobically degrade.

5.3 ROUTES OF MIGRATION

The following section describes the potential routes of chemical migration from the Production Area, Waste Water Treatment Area, and the Warwick Area. The purpose of this section is to develop a qualitative conceptual model of the site which describes the chemical transport pathways from each of the source areas and to provide a discussion of the contaminant pathways in conjunction with site-specific data obtained during the RFI.

5.3.1 Production Area

The Production Area consists of 6 SWMUs (SWMU-2, -3, -4, -7, -8, and -11), one AOC (AOC-13), and one AAOI (AAOI-15). A detailed description of each of these potential source areas is presented in Section 3.0.

The major pathway of chemical migration in the Production Area is the movement of chemicals through the surficial soils into the unsaturated zone of the Sand/Fill unit. The extent of vertical migration of chemicals through the unsaturated zone will be limited by the amount of infiltrating water, moisture content, effective porosity, soil bulk density, and the relative hydraulic conductivity of this unit. In addition, chemical properties including solubility, hydrophobicity, volatility, and degradation can limit migration. An evaluation of the hydrogeologic properties of this unit (Section 2.3.7.1) indicates that, in the Production Area, this unit consists predominantly of silty sand with hydraulic conductivities ranging from 135 to 293 ft/day. In addition, precipitation is expected to infiltrate directly through this unit to the water table. Therefore, chemicals penetrating the surficial soils are expected to migrate vertically through the unsaturated soils to the groundwater. These aqueous phase (dissolved) chemicals will then migrate horizontally towards the Pawtuxet River. Vertical migration of aqueous phase chemicals, between the upper and lower aquifers, will be dependent upon the vertical groundwater gradients. Vertical groundwater gradients are generally upward in the Production Area except in the area of the bulkhead where the shallow vertical groundwater gradients is downward. This is due to groundwater mounding in the upper overburden as a result of the influence of the bulkhead which acts as a low permeability barrier. Generally, downward gradients are present south of MW-10S/D (Section 2.3.4.1)whereas upward gradients are present in the northern portion of the Production Area.

The presence of the Silt unit underlying the Sand/Fill unit and overlying the Fine Sand unit acts as a semi-confining unit. Due to its lower hydraulic conductivity, this unit will limit the vertical migration of chemicals even though downward vertical groundwater gradients are present (Section 2.3.7.1). However, in the vicinity of MW-

10S/D, the Gravelly Sand unit penetrates the Sand/Silt unit and acts as a conduit for groundwater between the shallow overburden (Sand/Fill unit) and the deep overburden (Fine Sand unit). The presence of the Gravelly Sand unit in conjunction with the downward vertical gradients south of MW-10S/D create a potential for migration of mobile compounds into the lower aquifer zone in this area which ultimately discharges to the river.

VOCs present in the unsaturated Sand/Fill unit may have the potential to volatilize into the soil gas forming an organic vapor plume which can spread laterally through the unsaturated zone. These compounds may ultimately migrate to the groundwater as precipitation infiltrates through the vapor plume and dissolves vapor phase chemicals. Chemicals present in the groundwater will have a tendency to adsorb to the soil resulting in varying degrees of retardation of their transport in the groundwater.

5.3.1.1 Volatile Organic Compounds

VOCs detected in the shallow groundwater zone of the Production Area include chlorobenzene, ethylbenzene, xylene, and toluene. Chemicals detected in the soil gas include toluene, chlorobenzene, and xylenes in the area of SWMU-11 (Toluene Waste Water Release Area). VOCs detected in soils include toluene, ethylbenzene, and xylenes.

Analysis of the soil gas sampling during Phase I (Tracer, 1992) indicated that toluene, ethylbenzene, chlorobenzene, and xylenes were present in the unsaturated zone. The highest concentrations were detected in the vicinity of SWMU-11 with the highest toluene concentration of 18,000 ppb. The vapor pressure of toluene at 25 C is 28.4 mm Hg which is equivalent to a vapor concentration of approximately 141,000 ppb, which represents the maximum theoretical concentration in the soil gas, based on the following relationship:

$$C_{vapor} = n/V = p/RT$$

where:
n = *number of molecules in vapor (moles)*
V = *volume of vapor phase (liters)*
C_{vapor} = *vapor concentration (moles/liter)*
p = *vapor pressure of chemical (atm), where 1 atm = 760 mmHg*
R = *gas constant (liter atm / degree mole)*
T = *temperature (degrees Kelvin), where degrees Kelvin = degrees C + 273*

A concentration of 18,000 ppb is approximately 12 percent of the saturated vapor concentration. This elevated concentration is due to the close proximity of this sampling point to the source.

Monitoring well samples in the Production Area indicated the presence of ethylbenzene in the vicinity of SWMU-11, SWMU-7, and SWMU-8 with the highest concentration of 1,100 ppb in MW-1S.

The detection of ethylbenzene, xylenes, and toluene in MW-12D is potentially the result of the downward hydraulic gradients and the presence of the Sand/Gravel unit, which penetrates the Silt unit, in the vicinity of MW-10S/D (Figure 2-6, Cross-Section B). The presence of chlorobenzene in MW-31D is potentially the result of downward vertical groundwater flow in the area of the bulkhead. This is supported by the detection of chlorobenzene in MW-31S; however, since chlorobenzene was detected in lower concentrations in MW-31S there is also the potential for an upgradient source of chlorobenzene in the deep overburden.

These compounds are expected to be relatively mobile in groundwater, although they may exhibit some retardation, they will generally migrate with groundwater flow and ultimately discharge to the Pawtuxet River. It is unlikely that these chemicals will migrate under the river since the equipotential heads of the south side of the Pawtuxet River are higher than the river indicating that the river forms a groundwater divide with converging flow from the north and south (Figure 2-9).

5.3.1.2 Semi-Volatile Organic Compounds

SVOCs in general have lower solubilities and higher K_{ow} values than VOCs. Based on these chemical properties, SVOCs will generally have lower concentrations in groundwater and tend to be less mobile in groundwater and soils than VOCs. Likewise, SVOCs tend to be present at higher concentrations in the soils than VOCs.

SVOCs detected in groundwater in the Production Area include: di and trichlorobenzenes, chloro and methyl phenols, naphthalene, benzyl alcohol, Irgasan DP-300, and trichlorodibenzofuran. Di and trichlorobenzenes were detected most frequently in shallow wells associated with SWMU-11 with the highest levels of 230 ppb detected in MW-14S. In general, chlorinated benzene compounds have log K_{ow} values in the range of 3.4 to 3.6 which indicates that these compounds are moderately hydrophobic and therefore would tend to be retarded in groundwater. The detection of 1,2 dichlorobenzene in MW-12S, in conjunction with toluene, ethylbenzene, and xylenes, indicates the potential for dichlorobenzene to migrate in groundwater, however, the absence of 1,2- dichlorobenzene in MW-12D is likely the result of 1,2 dichlorobenzene being less mobile in groundwater than the VOCs detected in MW-12S.

Naphthalene was the most frequently PAH compound detected in groundwater in the Production Area. Concentrations ranged from 11 to 26 ppb in MW-1S and MW-2S which are located along the bulkhead. Naphthalene has the highest solubility and lowest log K_{ow} of the PAH compounds and therefore has the highest mobility in

groundwater. Concentrations of PAH compounds in soil were 8.4 ppm (sample SF-A13-A25) or less. Since PAH compounds are hydrophobic to strongly hydrophobic (Appendix 5-A, Section A.1.1.2),these compounds tend to adsorb to soils and therefore have low migration potentials. Therefore, high concentrations of PAHs in soils are expected only in close proximity to source areas. PAH compounds were not detected in the deep overburden aquifer which is also consistent with the low mobility of these compounds in groundwater.

Benzyl alcohol was detected in MW-14S at a concentration of 140 ppb. Benzyl alcohol is relatively mobile in groundwater and will migrate toward the Pawtuxet River. No detectable concentrations of benzyl alcohol were reported in soils.

Irgasan DP-300 was detected in the shallow overburden aquifer in the area of SWMU-11. Information on the physical and chemical properties of Irgasan is limited; however, this compound is characterized as having a low vapor pressure and a high molecular weight. This indicates that Irgasan has limited potential to volatilize and will have a low solubility and strong potential to adsorb to soil. The elevated concentration of this compound in MW-14S is likely due to a cosolvent effect as a result of the high concentrations of toluene, ethylbenzene, and xylenes in conjunction with the detection of high concentration of VOCs in this monitoring well. The dissolution of an organic compound in an organic solvent; such as a non-aqueous phase liquid or free product present in the subsurface, can often result in higher concentrations in groundwater than would normally be expected based solely on the compounds solubility. This process is known a cosolvency. Irgasan is not expected to exhibit significant mobility in groundwater in the absence of cosolvents.

5.3.1.3 PCBs

PCB compounds were detected in MW-12S at a maximum concentration of 30 ppb (Aroclor 1260), and in MW-5S at 1.7 ppb (Aroclor 1248). Soil sampling results indicated PCB concentrations as high as 4500 ppm (Aroclor 1248). PCBs are strongly hydrophobic compounds which have extremely limited mobilities in groundwater and low vapor pressures. Therefore, these compounds have a high affinity to adsorb to soils and a low mobility in groundwater which is consistent with the groundwater and soil sampling results. In addition, PCBs are more likely to dissolve in organic solvents than in water due to their hydrophobic nature and therefore would be strongly influenced by the presence of cosolvents. The detection of PCBs in MW-12S is probably the result of cosolvency due to the presence of NAPL in this well and is therefore not a valid representation of the true concentration of PCBs in the groundwater. PCBs adsorbed to soil/sediment particles may also be reported in unfiltered groundwater samples. PCBs are not expected to exhibit significant mobility in groundwater.

5.3.1.4 Pesticides

Pesticides were detected in the soils and groundwater at trace concentrations. Pesticides detected included gamma-chlordane, endrin aldehyde, and delta- and gamma-BHC. All pesticides were present in groundwater at concentrations less than 5 ppb. Pesticides in soils were present at concentrations less that 1 ppm. These compounds are expected to adsorb to soils, and exhibit limited mobility in groundwater.

5.3.1.5 Herbicides

Herbicides were detected at only trace concentrations in soils and groundwater with 1.4 ppb of 2,4-D in groundwater and less than 1 ppm in soils.

5.3.1.6 Dioxins / Furans

Only trace concentrations of dioxins and furans were detected in soils (< 1 ppb) and groundwater (0.003 ppb).

5.3.1.7 Inorganics / Metals

Metals and inorganics detected in the shallow and deep overburden aquifers included arsenic, chromium, calcium, iron, magnesium, sodium, and manganese. The groundwater has been characterized as a calcium bicarbonate type water based on water quality analysis. Therefore, concentrations of calcium, magnesium, and sodium are likely the result of the dissolution of natural minerals present in the aquifer matrix (i.e., calcite, dolomite). Maximum concentrations of arsenic and iron are higher in the deeper aquifer than the shallow aquifer. In addition, reported concentrations are comparable with background water concentrations with the average background concentrations of 34,388 and 21.16 ppb for iron and arsenic respectively. Average concentrations in the Production Area for iron and arsenic are 23,898 and 19.85 ppb. Higher background concentrations indicate that the presence of iron and arsenic is likely the result of the oxidation of sulfide minerals present in the bedrock and alluvial material (i.e., arsenopyrite, pyrite). This conclusion is further supported by similar concentrations in the deep overburden aquifer and the shallow system (26,319 ppb for iron and 17.36 ppb for arsenic). The concentration of total chromium is greater than dissolved chromium which suggests that the predominant mass of chromium is in the trivalent form. This indicates that the redox potential of the groundwater is moderately oxidizing but below the Cr^{+6} / Cr^{+3} boundary. This indicates that chromium present in the groundwater is likely to precipitate from solution, limiting its mobility in groundwater.

5.3.1.8 Production Area Summary

Based on the available information, VOCs have the highest potential to migrate in the groundwater and ultimately discharge to the river. Geological and hydrological information in conjunction with the distribution of VOCs indicate that chemicals present in the deep overburden aquifer are the result of the vertical migration of chemicals from the shallow aquifer due to the presence of the Sand/Gravel unit and the downward hydraulic gradients south of MW-10S/D. Chemicals present in both the shallow and deep overburden aquifers will ultimately discharge to the Pawtuxet River. The remaining organic chemical groups consist of hydrophobic chemicals which have little potential to migrate in the groundwater and therefore are unlikely to migrate to the river. Naphthalene is an exception since it has a higher water solubility and lower log Kow than SVOCs in general. Elevated concentrations of PCBs and Irgasan in groundwater are likely the result of cosolvent effected due to high concentrations of VOCs in MW-14S.

The presence of inorganics (calcium, magnesium, sodium, and potassium) in the groundwater are apparently the result of the dissolution of naturally occurring minerals in the bedrock and alluvium. The presence of iron and arsenic is most likely the result of the oxidation of sulfide minerals in the bedrock and alluvium due to their ubiquitous nature in the shallow and deep overburden aquifers. Chromium present in the groundwater is predominant in the solid form since total concentrations exceeded dissolved concentrations. This suggests that chromium is precipitating out of the groundwater in the Cr^{+3} form.

5.3.2 Waste Water Treatment Area

The Waste Water Treatment Area consists of SWMU-10 (Waste Water Pipeline Break) and SWMU-12 (Waste Water Treatment Plant). A detailed description of these sources is presented in Section 3.0.

The major chemical migration pathways in the Waste Water Treatment Area are the same as the Production Area except that vertical migration of groundwater to the lower aquifer unit is unlikely since the confining Silt unit is continuous across this area. Therefore, mobile chemicals which penetrate the surficial soils will migrate horizontally in the shallow overburden aquifer and discharge to the Pawtuxet River. The dominant chemicals detected in the groundwater of the Waste Water Treatment Area are the Fingerprint compounds which include Irgasan DP-300, Propazine, Tofranil, and Tinuvin 328. The dominant chemicals in soils included trichlorodibenzofuran, SVOCs, VOCs, PCBs (< 1 ppm), herbicides, and pesticides. Inorganic constituents above background include calcium, copper, potassium, and zinc. The soil gas survey indicated detectable levels of VOCs including toluene, ethylbenzene, xylenes, and chlorobenzene.

5.3.2.1 Volatile Organics

VOCs including ethylbenzene, toluene, xylenes, and chlorobenzene, were present in the shallow groundwater, soil, and soil gas in the vicinity of SWMU-12. The reported presence of these compounds in all three media is consistent with the physical and chemical properties of these chemicals as discussed in Section 5.3.1. Aqueous phase chemicals present in the shallow overburden aquifer will migrate toward and ultimately discharge to the Pawtuxet River.

5.3.2.2 Semi-Volatile Organics

SVOCs detected in the Waste Water Treatment Area include PAHs, phenols, and fingerprint compounds (Irgasan DP-300). SVOCs were detected in higher concentrations in the soils than in groundwater which is consistent with the strong potential that these chemical have to adsorb to soils. These chemicals include dibenzo(a,h) anthracene and fluorene which have log K_{ow} values of 6.8 and 4.2 respectively. SVOCs detected in groundwater include the more soluble constituents, primarily naphthalene and aniline. Naphthalene was detected in MW-7S, MW-9S, MW-15S, and MW-15D. A trace amount of naphthalene (12 ppb) was detected only once in the deep groundwater aquifer. The presence of naphthalene in the deep overburden aquifer was not verified in subsequent sampling events. Aniline was detected in MW-15S at concentrations of 76 ppb and 86 ppb. Aniline is soluble in groundwater and will migrate in groundwater with only minor retardation. Bis(2-ethylhexyl)phthalate was also detected once in MW-15D at a concentration of 130 ppb. This result is likely a laboratory artifact since this result was not reproduced in subsequent sampling events. In addition, bis(2-ethylhexyl)phthalate is strongly hydrophobic and therefore unlikely to migrate significant distances in groundwater.

5.3.2.3 PCBs

PCBs were not detected in groundwater. Only low concentrations (<1 ppm) were detected in soils. PCB are strongly hydrophobic and therefore have a strong affinity for soils. No substantial migration of PCBs from the Waste Water Treatment Area is expected.

5.3.2.4 Pesticides

Pesticides detected in the Waste Water Treatment Area included chlordane detected twice at concentrations of 19 ppm and 2.1 ppm in soil with trace concentrations of endrin aldehyde (1.6 ppb), and alpha-chlordane (1.2 ppb) in groundwater. Chlordane was detected in shallow and deep soils at concentrations of 19 ppm and 2.1 ppm, respectively. Chlordane is a strongly hydrophobic chemical and therefore is present predominantly in the soil phase and will be strongly retarded in the aqueous phase. No specific chemical or physical property information was available for endrin

aldehyde, however, based upon properties of other chemicals in this class, its mobility is expected to be limited. Based upon the low concentrations detected and limited mobility of these compounds, no significant transport of pesticides from the Waste Water Treatment Area is expected.

5.3.2.5 Herbicides

Herbicides were not detected in shallow or deep soil samples. The only herbicide detected in groundwater was dinoseb (0.038 ppb). The presence of this chemical is likely the result of agricultural land use in this area. Dinoseb is strongly hydrophobic and therefore is not expected to exhibit significant mobility in groundwater.

5.3.2.6 Dioxins / Furans

Trichlorodibenzofuran was detected in the soils at a concentration of 120 ppm. This chemical is strongly hydrophobic and therefore will strongly adsorb to soils. It is not expected to migrate to groundwater or exhibit significant mobility in groundwater.

5.3.2.7 Inorganics / Metals

Inorganic chemicals and metals in the Waste Water Treatment Area are present below background concentrations. Metals present in the shallow and deep soil samples (copper, zinc, arsenic) are likely present as solid phase or adsorbed since these chemicals were not detected in the shallow overburden aquifer.

5.3.2.8 Waste Water Treatment Area Summary

The transport of chemicals in the Waste Water Treatment Area is similar to the Production Area with VOCs representing the most mobile chemicals , however, VOCs were detected a lower concentrations in the Waste Water Treatment Area than in the Production Area.. These VOCs will ultimately discharge to the river. However, vertical transport to the deep overburden aquifer is limited due to the continuous nature of the Silt unit between the shallow and deep overburden aquifers in this portion of the site.

5.3.3 Warwick Area

The Warwick Area is located south of the Pawtuxet River and consists of 5 SWMUs (SWMU-1,-5,-6,-9,and -11). Chemicals detected in the groundwater of the Warwick Area include VOCs, trace levels of SVOCs, pesticides and herbicides, with above background levels of inorganic constituents such as calcium, zinc, barium, and arsenic. Soil constituents include VOCs, SVOCs, PCBs, and pesticides, with trace levels of herbicides and dioxins/furans. Inorganic constituents in the soils include cobalt, barium, cadmium, chromium, copper, nickel, zinc, and arsenic. VOCs were the only

constituents detected in the soil gas.

The Silt unit is continuous across the Warwick Area, separating the shallow and deep overburden. The shallow groundwater flows towards the Pawtuxet River. Mobile chemicals which reach groundwater in the shallow overburden will discharge to the river. Vertical migration of chemical constituents to the lower groundwater is unlikely due to the presence of the Silt unit.

5.3.3.1 Volatile Organics

No VOCs were detected in shallow soil samples in the Warwick Area. Samples taken from deep soils (2 to 4 feet bgs) indicated 510 ppm of chlorobenzene and 100 ppm of toluene in the vicinity of SWMU-5. VOC chemicals detected in the groundwater of the Warwick Area included chlorobenzene at concentrations up to 3,500 ppb and carbon disulfide at a concentrations of 920 ppb. These chemicals were associated with SWMU-5 and were detected in MW-11S. Carbon disulfide was detected in only one groundwater sampling event.

The VOCs present in soils will tend to leach downward to groundwater with infiltrating rainfall. No significant volatilization to the atmosphere is expected because VOCs were not in surface soils. Some volatilization from subsurface soils into the soil gas, with subsequent lateral transport may also occur. In the groundwater, chlorobenzene and carbon disulfide will exhibit some retardation due to their moderate hydrophobicity. However, these compounds will migrate with groundwater, ultimately discharging to the Pawtuxet River.

5.3.3.2 Semi-Volatile Organics

Trace concentrations of Propazine, Tinuvin, PAHs, and phthalates were detected in the shallow groundwater of the Warwick Area. Naphthalene (up to 32 ppm), bis(2-ethylhexyl)phthalate (up to 160 ppm) and di-n-octyl phthalate (up to 89 ppm) were detected in soils in the area of SWMU-5. No SVOCs were detected in the vicinity of SWMU-9 or SWMU-16. These compounds are expected to exhibit generally low mobility in soil and groundwater, with the exception of naphthalene, which is moderately mobile. The low reported groundwater concentrations, combined with the low mobility of these compounds, indicate little potential for significant transport of SVOCs from the Warwick Area in groundwater.

5.3.3.3 PCBs

PCB concentrations of 36 ppm for Aroclor 1254 and 160 ppm for Aroclor 1248 were detected in shallow soil samples in the vicinity of SWMU-5. No PCBs were detected in the groundwater of the Warwick Area which is consistent with the strong tendency for PCBs to adsorb to soils. Significant migration of PCBs from the Warwick Area is

not expected.

5.3.3.4 Pesticides

Only trace concentrations of organochlorine pesticides were detected in the shallow groundwater. Concentrations of methoxychlor (up to 2,200 ppm) were detected in the shallow and deep soils in the area of SWMU-5. Methoxychlor is strongly hydrophobic and therefore will strongly adsorb to the soils and exhibit little or no tendency to leach to groundwater. The low groundwater concentrations, combined with the low mobility of these compounds, indicates that the potential for transport of these compounds from the Warwick Area is minimal.

5.3.3.5 Herbicides

Only trace concentrations of herbicides were detected in the soils and groundwater of the Warwick Area. No substantial transport of these compounds is expected.

5.3.3.6 Dioxins / Furans

No dioxins or furans were detected in the soils and groundwater of the Warwick Area.

5.3.3.7 Inorganics / Metals

Elevated metals concentrations appear to be ubiquitous across this area with above background concentrations of cobalt, barium, cadmium, chromium, copper, nickel, zinc, and arsenic. Of these metals, arsenic and chromium have the highest potential to migrate in groundwater. However, as discussed in Section 5.3.1.7for the Production Area, arsenic in the groundwater and soils is likely the result of the oxidation of naturally occurring sulfide minerals such as arsenopyrite. Chromium is present mostly in the reduced form and therefore is likely to precipitate from solution. Cobalt, cadmium, copper, barium, nickel, and zinc will have a strong tendency to precipitate as insoluble minerals or to adsorb to soils and other minerals present on the alluvium. Therefore, these metals are not likely to migrate significantly in groundwater.

5.3.3.8 Warwick Area Summary

The major chemical migration pathway in the Warwick Area is the migration of moderately mobile chemicals, mostly VOCs, in the shallow overburden aquifer ultimately discharging to the Pawtuxet River. Vertical migration to the deep overburden aquifer in limited due to the continuous nature of the Silt unit dividing the shallow and deep overburden aquifers.

5.4 DEGRADATION OF CHEMICAL OF CONCERN

A summary of the chemicals present at the site and their potential to degrade both biologically and abiologically is summarized in Table 5.2. Degradation potential for the organic chemicals present in the soils and groundwater is chemical specific and cannot be quantified. However, general conclusions can be made based on the dominant chemicals of concern and the general geochemical environment.

Basic anion/cation analysis of the shallow and deep groundwater indicates that the groundwater is predominately a calcium bicarbonate type of water (see RFI Interim Report dated November 1991). Sulfate makes up approximately 30 percent of the major anions which naturally occur in groundwater. This indicates that sulfate reducing conditions do not exist in the shallow and deep overburden aquifers. Therefore, the geochemical environment is mostly an oxidizing environment. This is consistent with the hydrogeology which indicates that active recharge to the shallow overburden aquifer occurs as a result of infiltration from the surface. Based on this information, aerobic biodegradation is likely to be the major degradation process occurring at the site. The major chemicals detected in groundwater and soils were VOCs which have the highest potential to migrate through the groundwater and discharge to the Pawtuxet River. The dominant VOCs detected on the Site (toluene, ethylbenzene, xylenes, and chlorobenzene) also have the potential to aerobically degrade. However, these chemical tend to completely degrade to CO_2 and water; therefore, degradation cannot be confirmed based on the detection of daughter products.

5.5 PAWTUXET RIVER

Evaluation of the site geology and hydrogeology indicates that the Site groundwater discharges directly to the Pawtuxet River. Mobile chemicals (VOCs) present in the groundwater will ultimately discharge to the river. However, transport and fate processes at the groundwater/surface water interface will act to further attenuate chemicals. Abiotic processes such as photolysis and volatilization will result in the attenuation of chemicals reaching the river. Biodegradation rates of VOCs is expected to be much higher in the river than in groundwater. Riverbed sediments typically have higher organic carbon contents than the alluvial material in the shallow and deep overburden aquifers due to the higher biomass in the river than in the groundwater. Therefore, organic compounds will have a greater tendency to adsorb to river sediments. Microbial activity is also higher in the benthic zones of the river which will also increase potential biodegradation. Riverbed sediments also tend to have a higher cation exchange capacity and attenuation potential for inorganics and metals.

5.6 CONCLUSIONS

The assessment of the fate and transport of the chemicals of concern at the site indicate that VOCs have the highest mobility of the chemical groups identified. Therefore, these chemicals have the highest potential to migrate to the groundwater and discharge to the Pawtuxet River. Chemicals present in the groundwater in the Waste Water Treatment Area and the Warwick Area were present in the shallow groundwater and not in the deep groundwater. VOCs were present in both the shallow and deep groundwater in the Production Area. VOCs present in the deep aquifer in the Production Area are the result of downward vertical groundwater gradients as well as the presence of the Gravelly Sand unit which connects the shallow and deep aquifers.

Most SVOCs, PCBs, pesticides, herbicides, and dioxins/furans were present predominantly in the soils due to their strongly hydrophobic nature. Therefore, these chemicals are not expected to leach appreciably from the soils. Naphthalene, aniline, and benzyl alcohol, have high mobilities relative to the other SVOCs and may migrate with groundwater and ultimately discharge to the Pawtuxet River.

Table 5-1. Physical and Chemical Properties

	VAPOR PRESSURE (mm/Hg)	Henry's Law Constant (atm-cu.meter/mole)	Water Solubility (mg/L)	Log Kow (see notes)	Log Koc (see notes)	Molecular Weight (g/g mol)	Specific Gravity @ 20 degrees C	Water Solubility Description
VOLATILE ORGANICS								
HALOGENATED								
1,1,1-TRICHLOROETHANE	123.7 @ 25C	8.0x10-3	347 @ 25C	2.49	2.28	133.42	1.35 @20C	mod. hydrophobic
1,1-DICHLOROETHANE	227 @ 25 C	5.87 x 10-3	5060 @ 25 C	1.79	1.78	98.96	1.174	mod. hydrophobic
CHLOROBENZENE	11.9 @ 25C	3.45x10-3	471.7 @ 25C	2.84	2.53	112.56	1.113 @ 15.5C	mod. hydrophobic
CHLOROETHANE	1000 @ 20C	8.48x10-3	5740 @ 20C	1.43	1.52	64.52	0.92 @ 0C	mod. hydrophobic
CHLOROFORM	246 @ 25 C	4.35 x 10-3	7950	1.97	1.91	119.39	1.49 @ 15 C	mod. hydrophobic
IODOMETHANE	400 @ 25C	5.34x10-3	14,000 @ 20C	1.69	1.71	141.95	2.279 @ 20C	mod. hydrophobic
METHYLENE CHLORIDE	435 @ 25C	2.68x10-3	13,000 @ 20C	1.25	1.39	84.94	1.3255 @ 20C	mod. hydrophobic
TRANS-1,2-DICHLOROETHENE	340 @ 25 C	0.00672	6300 @ 25 C	2.06	1.97	96.94	1.26	mod. hydrophobic
TRICHLOROFLUOROMETHANE	802 @ 25C	0.097	1100 @ 25C	2.53	2.31	137.38	1.494 @ 17C	mod. hydrophobic
TETRACHLOROETHENE	18.49 @ 25C	1.49x10-2	1503 @ 25C	3.4	2.94	165.82	1.62	mod. hydrophobic
TRICHLOROETHENE	69 @ 25 C	1.03 x 10-2	1,100 @ 25 C	2.42	2.23	131.4	1.46	mod. hydrophobic
VINYL CHLORIDE	2660 @ 25C	1.07x10-2	2763 @ 25C	1.38	1.48	62.5	.9195 @ 15C	mod. hydrophobic
AROMATICS								
BENZENE	95 @ 25 C	5.43 x 10-3	1,791 @ 25 C	2.13	2.02	78.11	0.88	mod. hydrophobic
ETHYLBENZENE	9.53 @ 25C	8.44x10-3	161 @ 25C	3.15	2.76	106.16	.8669 @ 29C	mod. hydrophobic
M&P-XYLENE	8.28-8.74 @ 25 C	5.1x 10-3	200	3.15-3.20	2.76-2.80	106.16	0.86	mod. hydrophobic
O-XYLENE	6.6 @ 25 C	5.1 x 10-3	175 @ 25 C	3.12	2.74	106.16	0.86	mod. hydrophobic
STYRENE	6.6 @ 25C	2.81x10-3	310 @ 25C	2.95	2.61	104.16	0.9045	mod. hydrophobic
TOLUENE	28.4 @ 25 C	5.94 x 10-3	535 @ 25 C	2.73	2.46	92.13	0.87	mod. hydrophobic
KETONES/ALDEHYDES								
2-BUTANONE	90.6 @ 25 C	1.05 x 10-5	239,000	0.29	0.7	72.1	0.85	hydrophilic
ACETONE	231 @ 25 C	3.67 x 10-5	Miscible	-0.24	0.32	58.09	0.79	hydrophilic
OTHER VOLATILE ORGANICS								
CARBON DISULFIDE	297 @ 20 C	1.4 x 10-2	2,100 @ 20 C	1.84-2.16	1.81-2.05	76.13	1.26	mod. hydrophobic
N-OCTANE C	11 @ 20C	2.5	0.66 @ 20C	NA	NA	114.23	0.7028 @ 20C	hydrophobic
DIRECT INJECTION VOAS								
1,4-DIOXANE	38 @ 25C	4.88x10-6	miscible	-0.27	0.3	88.1	1.033 @ 20C	hydrophilic
SEMI-VOLATILE ORGANICS								
BASE NEUTRALS								
PAHs								
2-METHYLNAPTHALENE	NA	NA	NA	NA	NA	142.19	0.994	NA
7,12-DIMETHYLBENZ(A)ANTHRACENE	NA	4.4x10-3	NA	6.94	5.49	256.33	NA	strongly hydrophobic
ACENAPTHENE	1.55x10-3	9.20x10-5	3.42	4	3.37	154.21	1.069	hydrophobic
ACENAPHTHYLENE	2.90x10-2	1.48x10-3	3.93 @ 25C	3.7	3.154	152.2	0.899	mod. hydrophobic
ANTHRACENE	1.95x10-4	1.02x10-3	1.29 @ 25C	4.45	3.69	178.22	1.25	hydrophobic
BENZO(A)ANTHRACENE	5 x 10-9	1 x 10-6	4.4 x 10-2	5.61	4.53	228.28	NA	strongly hydrophobic
BENZO(A)PYRENE	5 x 10-9	5.53 x10-5	3.0 x 10-3	6.04	4.84	252.32	NA	strongly hydrophobic
BENZO(B)FLUORANTHENE	5 x 10-7	1.22 x 10-5	1.4 x 10-2	6.06	4.85	252.3	NA	strongly hydrophobic
BENZO(G,H,I)PERYLENE	1.03x10-10	5.34x10-8	7.0x10-4	6.51	5.17	276	NA	strongly hydrophobic
BENZO(K)FLUORANTHENE	5 x 10-7	3.87 x 10-5	4.3 x 10-3	6.06	4.85	252.32	NA	strongly hydrophobic
CHRYSENE	1 x 10-11	1.05 x 10-6	1.5 x 10-3	5.32	4.32	228.28	1.274 @ 20C	strongly hydrophobic
DIBENZ(A,H)ANTHRACENE	1.0x10-10	7.33x10-8	5.0x10-4	6.8	5.39	278.35	NA	strongly hydrophobic
DIBENZOFURAN	NA	NA	59.6 umoles/l	4.12	3.46	NA	NA	hydrophobic
FLUORANTHENE	1 x 10-6	NA	0.265	5.33	4.33	202.26	1.25	strongly hydrophobic
FLUORENE	7.1x10-4	6.42x10-5	1.69	4.2	3.51	116	NA	hydrophobic
INDENO(1,2,3-CD)PYRENE	1.0x10-10	6.86x10-8	5.3x10-4	6.5	5.17	276.34	NA	strongly hydrophobic
NAPTHALENE	.082 @ 25C	4.83x10-4	31.7 @ 25C	3.3	2.87	128.16	1.162	mod. hydrophobic

Table 5-1. Physical and Chemical Properties

	VAPOR PRESSURE (mm/Hg)	Henry's Law Constant (atm-cu.meter/mole)	Water Solubility (mg/L)	Log Kow (see notes)	Log Koc (see notes)	Molecular Weight (g/g mol)	Specific Gravity @ 20 degrees C	Water Solubility Description
PHENANTHRENE	6.8x10-4	1.59x10-4	1	4.46	3.79	178.22	1.025	hydrophobic
PYRENE	6.85 x 10-7	5.04x10-6	0.132	4.88	4	202.26	1.27	hydrophobic
PHTHALATES								
BIS(2-ETHYLHEXYL)PHTHALATE C	2 x 10-7	8.0x10-8	1.3	5.3	4.31	390.54	0.99	strongly hydrophobic
BUTYLBENZYLPHTHALATE	8.6x10-6 @ 20C	1.3x10-6	2.69 @ 25C	4.91	4.03	312.39	1.116 @ 25C	strongly hydrophobic
DIETHYLPHTHALATE	3.5x10-3	1.14x10-6	1,080	2.24	2.1	222.23	1.120 @ 25C	mod. hydrophobic
DIMETHYLPHTHALATE	1.65x10-3 @ 25C	1.1x10-7	4000 @ 25C	1.56	1.61	194.2	1.189@25C	mod. hydrophobic
DI-N-BUTYLPHTHALATE	1.4x10-5 @ 25C	4.6x10-7	11.2 @ 25C	4.72	3.89	278.34	1.0465	hydrophobic
DI-N-OCTYLPHTHALATE								
HALOGENATED								
1,2-DICHLOROBENZENE	1.0 @ 20C	.0012 @ 20C	100 @ 20C	3.38	2.92	147.01	1.307 @ 20C	mod. hydrophobic
1,3-DICHLOROBENZENE	2.3 @ 25C	.0018 @ 20C	111 @ 20C	3.6	3.08	147.01	1.288 @ 20C	mod. hydrophobic
1,4-DICHLOROBENZENE	1.76 @ 25C	.0015 @ 20C	87 @ 25C	3.52	3.02	147.01	1.4581 @ 20.5C	mod. hydrophobic
1,2,4-TRICHLOROBENZENE	.29 @ 25C	1.42x10-3	48.8 @ 20C	4.02	3.38	181.46	1.454 @ 25C	hydrophobic
2,2'-OXYBIS(1-CHLOROPROPANE)	0.85 @ 20C	1.13x10-4	1700	2.1	2	171	1.1135 @ 20C	mod. hydrophobic
3,3'-DICHLOROBENZIDINE	4.2x10-7 @ 25C	4.5x10-8 @ 25C	3.1 @ 25C	3.51	3.02	253.13	NA	mod. hydrophobic
4-CHLOROANILINE	.025 @ 25C	1.07x10-5	3900	1.83	1.81	127.58	1.427	mod. hydrophobic
BIS(2-CHLOROETHOXY)METHANE								
BIS(2-CHLOROETHYL)ETHER	1.55 @ 25C	2.86x10-4	1020 @ 20C	1.29	1.42	143.02	1.22 @ 20C	mod. hydrophobic
OTHER BASE NEUTRALS								
ACETOPHENONE C	1.0 @ 15C	2.87x10-5	5500	1.58	1.63	120.1	1.03	mod. hydrophobic
ANILINE C	.489 @ 25C	3.4x10-6	36,070 @ 25C	0.9	1.14	93.12	1.02 @ 20C	hydrophilic
1,1-BIPHENYL	NA	NA	7.5 @ 25C	3.16-4.09	2.77-3.43	154.2	1.041	mod. hydrophobic
2-NITROANILINE	NA	NA	1260 @ 25C	1.43-1.83	1.52-1.81	138.12	1.442 @ 20C	mod. hydrophobic
3,3'-DIMETHYLBENZIDINE								
DIPHENYLAMINE	NA	NA	300 @ 25C	3.22-3.50	2.81-3.01	169.23	1.159	mod. hydrophobic
NITROBENZENE	.15 @ 20C	2.44x10-5	1900 @ 20C	1.85	1.82	123.11	1.205 @ 25C	mod. hydrophobic
N-NITROSODIMETHYLAMINE	NA	NA	miscible	NA	NA	NA	1.048 @ 20C	hydrophilic
N-NITRO-DI-N-PROPYLAMINE								
PHENACETIN	NA	NA	NA	NA	NA	179.21	NA	NA
P-PHENYLENEDIAMINE	NA	NA	8000 @ 24C	NA	NA	108.14	NA	mod. hydrophobic
ACID EXTRACTABLES								
PHENOLS								
2-CHLOROPHENOL	1.42 @ 25C	5.6x10-7	28 @ 25C	2.15	2.04	128.56	1.256 @ 25C	mod. hydrophobic
2-METHYLPHENOL	.31 @ 25C	1.6x10-6	30,800 @ 40C	1.95	1.89	108.15	1.034 @ 20C	mod. hydrophobic
2-NITROPHENOL	.20 @ 25C	3.5x10-6	1060 @ 20C	1.79	1.78	139.11	1.495 @ 20C	mod. hydrophobic
3-CHLOROPHENOL	.119 @ 25C	5.6x10-7	26,000 @ 25C	2.5	2.29	128.56	1.245	mod. hydrophobic
3-METHYLPHENOL	.143 @ 25C	8.7x10-7	23,000 @ 25C	1.96	1.9	108.15	1.034 @ 20C	mod. hydrophobic
4-METHYLPHENOL	.13 @ 25C	9.6x10-7	22,600 @ 40C	1.94	1.89	108.13	1.034 @ 20C	mod. hydrophobic
4-NITROPHENOL	.001 @ 25C	3.31x10-8	11,300 @ 20C	1.91	1.87	139.11	1.270 @ 120C	mod. hydrophobic
4-CHLORO-3-METHYLPHENOL	NA	NA	NA	3.1	2.72	142.6	NA	mod. hydrophobic
2,4-DICHLOROPHENOL	NA	NA	4600 @ 20C	NA	NA	163.01	1.383 @ 60C	mod. hydrophobic
2,4-DIMETHYLPHENOL	.098 @ 25C	6.3x10-7 @ 8C	6200 @ 25C	2.3	2.15	122.16	NA	mod. hydrophobic
2,6-DICHLOROPHENOL	NA	NA	NA	NA	NA	163	NA	NA
3-METHYLPHENOL C	0.04 @ 20C	2.42x10-7	23,500 @ 20C	1.96-2.01	1.90-1.94	108.13	1.038 @ 20C	mod. hydrophobic
4-METHYLPHENOL C	0.04 @ 20C	2.38x10-7	24,000 @ 40C	1.92-1.94	1.87-1.89	108.13	1.0347 @ 20C	mod. hydrophobic
PENTACHLOROPHENOL	.00011 @ 25C	2.75x10-6	14 @ 20C	5.12	4.18	266.35	1.978	strongly hydrophobic
PHENOL	.524 @ 25C	3.97x10-7	87,000 @ 25C	1.46	1.54	94.11	1.072	mod. hydrophobic
OTHER ACID EXTRACTABLES								

Table 5-1. Physical and Chemical Properties

	VAPOR PRESSURE (mm/Hg)	Henry's Law Constant (atm-cu.meter/mole)	Water Solubility (mg/L)	Log Kow (see notes)	Log Koc (see notes)	Molecular Weight (g/g mol)	Specific Gravity @ 20 degrees C	Water Solubility Description
2-CYCLOHEXENE-1-OL	SUSPECTED LAB CONTAMINANT							
2-CYCLOHEXENE-1-ONE	SUSPECTED LAB CONTAMINANT							
BENZYL ALCOHOL C	1.0 @ 58C	4.0x10-6	35,000 @ 20C	1.1	1.28	108.13	1.05 @ 15C	mod. hydrophobic
BUTAZOLIDIN	NA	NA	700-2200 @ 22C	NA	NA	308.37	NA	mod. hydrophobic
O-TOLUIDINE C	0.1 @ 20C	9.4x10-7	15,000 @ 25C	1.29-1.32	1.42-1.44	107.15	1.04 @ 20C	mod. hydrophobic
FINGERPRINT COMPOUNDS								
IRGASAN DP-300	4x10-6@20C					289.53		NA
PROPAZINE	1.3 x 10-7 @25C	1.32x10-8 @25C	3@20C	3.01	2.66	230.09		mod. hydrophobic
TINUVIN 327 C	8.0 x10-9	3.77 x10-5	1.0 x10-4	5.76	4.64	357.9		strongly hydrophobic
TINUVIN 328								
TOFRANIL								
PCBS								
PCBs (generic)	7.7x10-5	1.07x10-3	3.1x10-2	6.04	4.84	328	NA	strongly hydrophobic
PCB-1248	4.94x10-4	3.5x10-2	5.0x10-2	6.11	5.64	288	1.41@25C	strongly hydrophobic
PCB-1254	4.30 x10-5	2.0 x 10-4	0.057 @ 24C	6.33	5.01	328	1.505 @ 15.5C	strongly hydrophobic
PCB -1260	4.05x10-5	7.1x10-4	0.08 @ 24C	6.91	6.47	370	1.566 @ 15.5C	strongly hydrophobic
ORGANOCHLORINE PESTICIDES								
4,4'-DDD	1.89x10-6	7.96x10-6	0.16 @ 24C	6.2	4.95	320.1	NA	strongly hydrophobic
4,4'-DDE	6.50x10-6	6.80x10-5	0.04 @ 20C	4.28-5.69	3.57-4.59	318	NA	strongly hydrophobic
4,4'-DDT	5.05x10-3	5.13x10-4	5.0x10-3	6.19	4.97	354.5	NA	strongly hydrophobic
ALDRIN	3.75x10-5	.496x10-3	.02 @ 20C	6.5	5.17	364.93	1.7	strongly hydrophobic
ALPHA-BHC	4.50x10-5 @ 25C	1.06x10-5	2.0 @ 20C	3.8	3.23	290.85	NA	mod. hydrophobic
ALPHA-CHLORDANE	4.6x10-4	8.6x10-4	0.1 @ 25C	5.54	4.48	409.8	1.57-1.63@15.5C	strongly hydrophobic
BETA-BHC	2.8x10-7	4.47x10-7	0.24	3.9	3.3	290.85	NA	mod. hydrophobic
CHLOROBENZILATE	2.2x10-6	7.24x10-8	13 @ 20C	4.36	3.63	325.2	NA	strongly hydrophobic
DELTA-BHC	1.7x10-5	2.07x10-7	31.4	4.1	3.44	290.85	NA	strongly hydrophobic
DIELDRIN	3.75x10-6 @ 20C	5.8x10-5 @ 25C	.17 @ 20C	4.32	3.6	380.93	1.75	strongly hydrophobic
ENDOSULFAN I	1.0x10-5 @ 25C	1.12x10-5	.51 @ 20C	3.83	3.25	406.95	1.745	mod. hydrophobic
ENDOSULFAN II	1.0x10-5 @ 25C	1.12x10-5	.45 @ 20C	3.83	3.25	406.95	1.745	mod. hydrophobic
ENDOSULFAN SULFATE								
ENDRIN	3.0x10-6 @ 20C	7.52x10-6	2.5x10-3 @ 25C	4.56	3.77	380.9	NA	strongly hydrophobic
ENDRIN ALDEHYDE								
GAMMA-BHC (Lindane)	5.57x10-5 @ 25C	2.92x10-6 @ 25C	7.3	3.61	3.09	290.85	1.87	mod. hydrophobic
GAMMA-CHLORDANE		1.3 x10-3 @ 25C						
HEPTACHLOR	4.0x10-4 @ 25C	1.48x10-3	0.18	5.27	4.28	373.35	1.57-1.59	strongly hydrophobic
HEPTACHLOR EPOXIDE	1.95x10-5	3.2x10-5	0.2	5.4	4.38	389.4	NA	strongly hydrophobic
ISODRIN	NA	NA	Insoluble	NA	NA	364.9	NA	NA
KEPONE	3.0x10-7	2.5x10-8	7.6 @ 25C	4.5	3.73	490.68	NA	strongly hydrophobic
METHOXYCLOR	1.43x10-6 @ 25C	1.58x10-5 @ 25C	.045 @ 25C	4.68-5.08	3.86-4.15	345.65	1.41	strongly hydrophobic
ORGANOPHOSPHORUS PESTICIDES								
DISULFOTON	1.8x10-4 @ 20C	3.99x10-6 @ 20C	16.3 @ 20C	4.02	3.38	274.38	NA	strongly hydrophobic
DIMETHOATE	5.1x10-6 @ 25C	6.15x10-11	25,000 @ 21C	.50,.78	.85,1.05	229.28	NA	hydrophilic
ETHYL PARATHION	9.65x10-6	5.65x10-7	6.54 @ 24C	3.83	3.18	291.27	1.26 @ 25C	mod. hydrophobic
FAMPHUR	NA	NA	NA	NA	NA	325.36	NA	NA
METYL PARATHION	9.6x10-6 @ 20C	1.0x10-7 @ 20C	50	2.86	2.55	263.23	1.235 @ 20C	mod. hydrophobic
PHORATE C	8.4x10-4 @ 20C	5.82x10-6	50	NA	NA	260.4	1.156 @ 20C	NA
SULFOTEPP C	1.7x10-4 @ 20C	2.89x10-6	25	NA	NA	322.2	1.196 @ 25C	NA

Table 5-1. Physical and Chemical Properties

	VAPOR PRESSURE (mm/Hg)	Henry's Law Constant (atm-cu.meter/mole)	Water Solubility (mg/L)	Log Kow (see notes)	Log Koc (see notes)	Molecular Weight (g/g mol)	Specific Gravity @ 20 degrees C	Water Solubility Description
THIONAZIN	3.3x10-3 @ 30C	NA	NA	NA	NA	NA	NA	NA
HERBICIDES								
2,4-D	1.05x10-2 @ 25C	1.37x10-10	682 @ 25C	2.81	2.51	221.04	1.416	mod. hydrophobic
2,4,5-T	<7.5x10-7 @ 20C	8.68x10-9	278 @ 25C	3.13	2.74	255.49	1.8	mod. hydrophobic
2,4,5-TP(SILVEX)	5.2x10-6 @ 25C	1.31x10-8	140 @ 25C	3.41	2.95	269.51	NA	mod. hydrophobic
DINOSEB	7.5x10-2 @ 20	5.04x10-4 @ 20C	52 @ 25C	3.69	3.15	240.2	1.29 @ 30C	mod. hydrophobic
DIOXINS AND FURANS								
2,3,7,8-TCDD	1.7 x 10-6	3.6 x 10-3	2.0 x 10-4	6.18	4.94	322		strongly hydrophobic
2,3,7,8-TCDF								
DCDD								
DCDF								
HXCDF								
OCDD								
PECDD								
PECDF								
HPCDF								
OCDD								
1,2,3,4,6,7,8-HPCDD								
1,2,3,4,6,7,8-HPCDF								
HPCDD								
HPCDF								
OCDD								
OCDF								
OCDD								
TCDF								
TRCDF (2,3,7,8-TCDD properties used)	1.7 x 10-6	3.6 x 10-3	2.0 x 10-4	6.18	4.94	322		strongly hydrophobic

References:

Howard, Handbook of Environmental Fate and Transport for Organic Chemicals, Volumes I,II,and III, Lewis Publishers(1990).

Verscheuren, Handbook of Environmental Data on Organic Chemicals, Second Edition (1983).

"Aquatic Fate and Process Data of Organic Priority Pollutants",U.S.EPA -440/4-81-014 (1982).

"Assessing Human Health Risks from Chemically Contaminated Fish and Shellfish", U.S. EPA No. 503/8-89-002 (1989).

"Toxicological Profile for Carbon Disulfide, Agency for Toxic Substances and Disease Registry" (draft) 10/90.

Windholz (Editor), The Merck Index, Tenth Edition, (1983).

"Extremely Hazardous Substances", Superfund Chemical Profiles, Volume I, Noyes Data Corp., (1988).

Hawley's Condensed Chemical Dictionary, Van Nostrand Reinhold Co., (1987).

"Superfund Public Health Evaluation Manual", U.S. EPA 540/1-86/060

Notes:

For some coompounds the Henry's Law Constant was calculated from available vappor pressure and water solubility data.

Log Koc based on the linear regression relationship established by Schwertzenback: Westall, 1981 log Koc = 0.49 + 0.72 log Kow

Log Kow = logarithm (base 10) of the octanol/water partition coefficient

Log Koc = logarithm (base 10) of the organic carbon/water partition coefficient

NA = Not Available

TABLE 5-2
POTENTIAL DEGRADATION MODES AND DEGRADATION PRODUCTS

	Description	
Chemical Group/Chemical	**Abiotic**	**Biodegradation**
Organochlorine Pesticides		
gamma-chlordane (based on alpha and gamma chlordane and technical chlordane data)	Insignificant through hydrolysis, oxidation or photolysis. Degradation products not available.	Anaerobic biodegradation favored. Degradation products may include: heptachlor, heptachlor endo-epoxide.
delta-BHC (based on alpha and gamma-BHC)	Significant hydrolysis may occur in basic condition. No data on photolysis expected to be negligible. Degradation products not available.	Anaerobic biodegradation favored. Degradation products not available.
endrin aldehyde (based on endrin)	Strong resistance to photolysis and hydrolysis. May photo isomerize to endrin ketone.	Biodegradation unfavorable.
4,4-DDT	Expected to be minimal.	Expected to be minimal.
methoxychlor	Hydrolysis, photolysis, oxidation insignificant. May undergo rapid photooxidation to anisoin and anisil.	Anaerobic conditions favored. Degrades to dechlorinated methoxychlor (DMDD), mono and dihoxydroxy derivatives of methoxychlor and DMDD.
PCBs		
Aroclor-1248	Resistant?	Resistant?
Aroclor-1254	Resistant?	Resistant?
Aroclor-1260	Resistant?	Resistant?
Organophosphorus Pesticides		
Dimethoate	Susceptible to hydrolysis in soils and significant hydrolysis in water. Hydrolysis favored as pH increases.	Susceptible to slow aerobic and anaerobic degradation. Aerobic conditions favored.

TABLE 5-2
POTENTIAL DEGRADATION MODES AND DEGRADATION PRODUCTS

	Description	
Chemical Group/Chemical	**Abiotic**	**Biodegradation**
Herbicides		
2,4-D	Primarily resistant to hydrolysis. May be susceptible to photolysis. Degradation products include 2,4-dichlorophenol.	Susceptible to aerobic and anaerobic degradation. Aerobic conditions favored.
2,4,5-T	Primarily resistant to hydrolysis and oxidation. May be susceptible to photolysis.	Susceptible to aerobic and anaerobic degradation. Aerobic conditions favored. Primarily degrades to 2,4,5-trichlorophenol. Anaerobically can degrade to di and monochlorophenols.
2,4,5-TP (silvex)	Not available.	Not available.
Dinoseb	Susceptible to photolysis. Degradation products not available.	Susceptible to aerobic and anaerobic degradation. Anaerobic conditions favored. Degradation products not available.
Volatile Organics		
chlorobenzene	Resistant to photolysis, hydrolysis or oxidation.	Susceptible to aerobic and anaerobic degradation. Aerobic conditions favored. Degradation products include 2-chlorophenol, 4-chlorophenol.
carbon disulfide	Photolysis not significant. Photooxidizes to carbon monoxide, carbonyl sulfide, sulfur dioxide.	Difficult to degrade.

TABLE 5-2
POTENTIAL DEGRADATION MODES AND DEGRADATION PRODUCTS

	Description	
Chemical Group/Chemical	**Abiotic**	**Biodegradation**
ethylbenzene	Resistant to hydrolysis. Photolysis considered insignificant but may be photooxidized.	Biodegrades aerobically and anaerobically. Aerobic conditions favored.
toluene	Subject to photooxidation. Will not significantly hydrolyze or directly photolyze.	Biodegrades aerobically and anaerobically. Aerobic conditions favored.
xylenes	Not significant source of degradation in soils and groundwater.	Biodegrades aerobically and anaerobically. Aerobic conditions favored.
Semi-Volatile Organics		
benzyl alcohol	Not available.	Not available.
4-chloroanaline	Susceptible to photooxidation- to 4-chloronitrobenzene.	Aerobically and chemically degrades via mineralization in soils to CO_2.
chlorophenols	Will not hydrolyze. Susceptible to photolysis. Degradation products include pyrocatachol and cyclopentadienic acid.	Susceptible to aerobic and anaerobic degradation. Aerobic conditions favored.
bibenzofuran	Not available.	Susceptible to aerobic and anaerobic degradation. Aerobic conditions favored.
dichlorobenzenes	Degradation through hydrolysis, photolysis and oxidation considered insignificant.	Susceptible to slow aerobic degradation.
Irgasan DP-300	Not available	Not available.
PAHs	Not susceptible to hydrolysis. Susceptible to photolysis.	Susceptible to aerobic biodegradation.
phenol	Not susceptible to hydrolysis. Susceptible to photolysis.	Degrades aerobically and anaerobically. Aerobic conditions favored.

TABLE 5-2
POTENTIAL DEGRADATION MODES AND DEGRADATION PRODUCTS

	Description	
Chemical Group/Chemical	**Abiotic**	**Biodegradation**
phthalates	Hydrolysis, photolysis, photooxidation considered slow.	Susceptible to aerobic biodegradation.
propazine	Not available.	Not available.
methylphenol	Will not hydrolyze, subject to photolysis.	Susceptible to aerobic and anaerobic degradation. Aerobic conditions favored.
Tinuvin 327 or 328	Not available.	Not available.
Trichlorobenzene	Will not hydrolyze. Photolysis and oxidation insignificant.	Susceptible to slow aerobic and anaerobic degradation. Aerobic conditions favored.
Dioxins/Furans		
trichlorodibenzofuran or 2,3,7,8-TCDD	Susceptible to photolysis, will not hydrolyze.	Biodegradation process insignificant.

References:

Information garnered from the physical and chemical properties summarized in Table 5-1 and the following references: Howard, Handbook of Environmental Fate and Transport for Organic Chemicals, Volumes I, II, and III, Lewis Publishers (1990).

TABLE 5-3
TRANSPORT PROPERTIES

Chemical Group/Chemical	Mobility	Volatility	Areas Detected
Organochlorine Pesticides/PCBs			
gamma-chlordane (based on alpha-chlordane, gamma-chlordane, chlordane data)	Extremely low mobility in GW and soil due to strong hydrophobic nature, strong tendency to adsorb to soil/sediment.	Low vapor pressure and strong tendency to adsorb to soil/sediment substantially limits volatilization to soil gas. Expected to exhibit volatility from GW based on Henry's Law constant.	Production Area GW and Soil Warwick Area GW and Soil Waste Water Treatment Area GW and Soil Background Area Soil
delta-BHC	Extremely low mobility in GW and soil due to strong hydrophobic nature, strong tendency to adsorb to soil/sediment.	Expected to exhibit low volatility from GW and soil.	Production Area GW and Soil Warwick Area GW and Soil Waste Water Treatment Area GW and Soil Background Area Soil
gamma-BHC	Moderate mobility in GW and soil, will adsorb to soil/sediment.	Expected to exhibit low volatility from GW and soil.	Production Area GW and Soil Warwick Area GW and Soil Waste Water Treatment Area Soil Background Area Soil
endrin aldehyde (based on endrin)	Limited mobility in GW and soil due to hydrophobic nature, tendency to adsorb to soil/sediment.	Expected to exhibit low volatility from GW and soil.	Production Area GW and Soil Warwick Area Soil Waste Water Treatment Area GW and Soil Background Area Soil
4,4'-DDT	Extremely low mobility in GW and soil due to strong hydrophobic nature, strong tendency to adsorb to soil/sediment.	Expected to exhibit limited volatility from GW and soil.	Production Area GW and Soil Warwick Area GW and Soil Waste Water Treatment Area GW and Soil Background Area GW and Soil
methoxychlor	Limited to extremely limited mobility in GW and soil due to strong hydrophobic nature, strong tendency to adsorb to soil/sediment.	Expected to exhibit low volatility from GW and soil.	Production Area Soil Warwick Area Soil Background Area Soil

TABLE 5-3
TRANSPORT PROPERTIES

Chemical Group/Chemical	Mobility	Volatility	Areas Detected
PCBs			
Aroclor-1248	Extremely limited mobility in GW and soil due to strong hydrophobic nature, strong tendency to adsorb to soil/sediment.	Low vapor pressure and strong tendency to adsorb to soil/sediment substantially limits volatility. Expected to exhibit volatility from GW based on Henry's Law constant.	Production Area GW and Soil Warwick Area Soil
Aroclor-1254	Extremely limited mobility in GW and soil due to strong hydrophobic nature, strong tendency to adsorb to soil/sediment.	Low vapor pressure and strong tendency to adsorb to soil/sediment substantially limits volatility. Expected to exhibit volatility from GW based on Henry's Law constant.	Production Area Soil Warwick Area Soil Waste Water Treatment Area Soil Background Area Soil
Aroclor-1260	Extremely limited mobility in GW and soil due to strong hydrophobic nature, strong tendency to adsorb to soil/sediment.	Low vapor pressure and strong tendency to adsorb to soil/sediment substantially limits volatility. Expected to exhibit volatility from GW based on Henry's Law constant.	Production Area GW and Soil
Organophosphorous Pesticides			
Dimethoate	Highly mobile in GW and soil due to high solubility, little tendency to adsorb to soil/sediment.	Expected to exhibit little volatil- ity from GW or soil. However, loss from evaporation on surface soils may be significant.	Production Area GW Warwick Area GW Waste Water Treatment Area Soil
Herbicides			
2,4-D	Moderate mobility in water and soils due to hydrophobic nature, tends to adsorb to soil/sediment.	Expected to exhibit little volatil-ity from GW and soil. However, tends to biodegrade in both media.	Production Area GW and Soil Warwick Area Soil Waste Water Treatment Area Soil Background Area Soil

TABLE 5-3
TRANSPORT PROPERTIES

Chemical Group/Chemical	Mobility	Volatility	Areas Detected
2,4,5-T or 2,4,5-TP (silvex)	Moderate mobility in water and soils due to hydrophobic nature, tends to adsorb to soil/sediment.	Expected to exhibit little volatil-ity from GW and soil. However, moderately photo and biodegradable in GW and soil.	Production Area GW and Soil Warwick Area GW and Soil Waste Water Treatment Area Soil Background Area Soil
dinoseb	Moderate mobility in water and soils due to hydrophobic nature, tends to adsorb to soil/sediment.	Expected to exhibit moderate volatility from GW and soil. Susceptible to biodegradation in soils. Susceptible to photo-degradation in surface water.	Production Area GW and Soil Warwick Area GW and Soil Waste Water Treatment Area GW Background Area Soil
Volatile Organics			
chlorobenzene	Moderate mobility in GW and soil, some tendency to adsorb to soil/sediment is likely.	Expected to exhibit moderate volatility from GW and soil.	Production Area GW and Soil Warwick Area GW and Soil Waste Water Treatment Area GW and Soil Background Area GW
carbon disulfide	Moderate mobility in GW and soil, some tendency to adsorb to soil/sediment is likely.	Expected to volatilize from GW and soil.	Warwick Area GW
ethylbenzene	Moderate mobility in GW and soil, some tendency to adsorb to soil/sediment is likey.	Expected to volatilize from GW and soil.	Production Area GW and Soil Warwick Area GW and Soil Waste Water Treatment Area GW and Soil Background Area GW
toluene	Moderate mobility in GW and soil, some tendency to adsorb to soil/sediment is likely.	Expected to volatilize from GW and soil.	Production Area GW and Soil Warwick Area GW and Soil Waste Water Treatment Area GW and Soil Background Area Soil

TABLE 5-3
TRANSPORT PROPERTIES

Chemical Group/Chemical	Mobility	Volatility	Areas Detected
xylenes	Moderate mobility in GW and soil, some tendency to adsorb to soil/ sediment is likely.	Expected to volatilize from GW and soil.	Production Area GW and Soil Warwick Area GW and Soil Waste Water Treatment Area GW and Soil Background Area Soil
Semi-Volatile Organics			
benzyl alcohol	Mobile in GW and soil based on high solubility, little tendency to adsorb to soils.	Expected to exhibit low volatility from GW and soil.	Production Area GW
4-chloroaniline	Moderate mobility in GW and soil due to moderate hydrophobic nature, some tendency to adsorb to soil/sediment.	Expected to exhibit low volatility from GW and soil.	Production Area GW and Soil Warwick Area GW and Soil Waste Water Treatment Area GW and Soil
aniline	Extremely mobile in groundwater/ hydrophilic.	Expected to inhibit low volatility from groundwater and soil.	Waste Water Treatment Area
chlorophenols	Moderate mobility in GW and soil due to moderate hydrophobic nature, some tendency to adsorb to soil/sediment.	Expected to exhibit low volatility from GW and soil.	Production Area GW and Soil Warwick Area GW and Soil Waste Water Treatment Area GW and Soil
dibenzofuran	Extremely limited mobility in GW and soil due to strong hydrophobic nature, strong tendency to adsorb soil/sediment.	Expected to exhibit low volatility from GW and soil based on low aqueous solubility.	Production Area Soil Warwick Area Soil Waste Water Treatment Area GW and Soil Background Area GW and soil
dichlorobenzenes	Moderate mobility in GW and soils, some tendency to adsorb to soils is likely.	Expected to volatilize from GW and soil.	Production Area GW and Soil Warwick Area Soil Waste Water Treatment Area GW

TABLE 5-3
TRANSPORT PROPERTIES

Chemical Group/Chemical	Mobility	Volatility	Areas Detected
Irgasan DP-300	Unknown	Expected to exhibit low to no volatility from GW and soil based on vapor pressure.	Production Area GW and Soil Waste Water Treatment Area GW and Soil
PAH (general)	Limited to extremely limited mobility in GW and soil due to hydrophobic to strong hydrophobic nature, tends to adsorb or strongly adsorb to soil/ sediment.	Expected to exhibit low volatility from GW and soil.	Production Area GW and Soil Warwick Area GW and Soil Waste Water Treatment Area GW and Soil Background Area GW and Soil
naphthalene	Moderate mobility in groundwater and soil, some tendency to adsorb to soil/sediment.	Expected to exhibit moderate volatility from groundwater and soil.	Production Area GW and Soil Warwick Area GW and Soil Waste Water Treatment Area
phenol	Moderate mobility in GW and soil due to moderate hydrophobic nature, some tendency to adsorb to soil/sediment.	Expected to exhibit moderate to low volatility from GW and soil.	Production Area GW and Soil Warwick Area GW and Soil Waste Water Treatment Area GW and Soil
phthalates (general) (e.g., bis(2-ethylhexyl) phthalate	Extremely limited mobility in GW and soil due to strong hydrophobic nature, strong tendency to adsorb to soil/sediment.	Expected to exhibit low to no volatility from GW and soil.	Production Area GW and Soil Warwick Area GW and Soil Waste Water Treatment Area GW and Soil Background Area GW and Soil
propazine	Low to mederate mobility in GW and soil based on solubility.	Unknown	Warwick Area GW and Soil Waste Water Treatment Area GW and Soil
methylphenols	Moderate mobility in GW and soils due to moderate hydrophobic nature, some tendency to absorb to soil/sediment.	Expected to exhibit low volatility from GW and soils, however, volatilization from surface soils could occur.	Production Area GW and Soil Warwick Area Soil Waste Water Treatment Area GW and Soil Background Area GW and Soil

TABLE 5-3
TRANSPORT PROPERTIES

Chemical Group/Chemical	Mobility	Volatility	Areas Detected
Tinuvin 327 or 328	Extremely limited mobility in GW and soil due to strong hydrophobic nature, strong tendency to adsorb to soil/sediment.	Expected to exhibit low volatility from GW and soil.	Production Area GW Warwick Area GW and Soil Waste Water Treatment Area GW and Soil
trichlorobenzene (1,2,4-trichlorobenzene)	Extremely limited mobility in GW and soil due to strong hydrophobic nature, strong tendency to adsorb to soil/sediment.	Expected to exhibit volatility from GW; volatilization slowed in soils/ sediments due to strong adsorption.	Production Area GW and Soil Waste Water Treatment Area Soil
Dioxins/Furans			
trichlorodibenzofuran (based on 2,3,7,8-TCDD) or PCDFs	Extremely limited mobility in GW and soil due to strong hydrophobic nature, strong tendency to adsorb to soil/sediment.	Low vapor pressure and strong tendency to adsorb substantially limits volatility. Expected to exhibit volatility from GW based on Henry's Law constant.	Production Area GW and soil Waste Water Treatment Area GW and Soil Background Area GW and Soil
2,3,7,8-TCDD or PCDDs	Extremely limited mobility in GW and soil due to strong hydrophobic nature, strong tendency to adsorb to soil/sediment.	Low vapor pressure and strong tendency to adsorb substantially limits volatility. Expected to exhibit volatility from GW based on Henry's Law constant.	Production Area Soil Warwick Area GW and Soil Background Area GW and Soil

References:

Information garnered from the physical and chemical properties summarized in Table 5-1 and the following references: Howard, Handbook of Environmental Fate and Transport for Organic Chemicals, Volumes I, II, and III, Lewis Publishers (1990).

Summary

A Public Health and Environmental Risk Evaluation (PHERE) was prepared as part of the RFI, as required in the Order. It separately evaluates the potential human health and ecological risks associated with the Production, Waste Water Treatment, and Warwick Areas. It is consistent with the approach outlined in the USEPA's primary risk assessment guidance documents. The PHERE approach and values for exposure assumptions reflect discussions held with the Region I during several meetings and teleconferences, beginning with the May 17, 1994, meeting with Ciba at the Region I offices. The PHERE is presented in two parts; the public health risk assessment (PHRA) and the ecological risk assessment. The PHERE is a quantitative baseline study which assumes the property will be used without modification regardless of the practicality of this assumption. The risk reduction effectiveness of IRMs conducted in the Production and Warwick Areas is addressed qualitatively.

The purpose of the PHERE is threefold:

- Provide estimates of potential risks posed by site-related chemicals in the Production, Waste Water Treatment, and Warwick Areas of the Site using the conservative guidance specified by Region I.
- Identify the site areas and chemicals that might require corrective action using this risk assessment approach.
- Provide site-specific risk assessment models for human and ecological health to be used in developing risk-based Media Protection Standards (MPS) for soil, if needed.

Public Health Risk Assessment

The PHRA is designed to provide a conservative, quantitative estimate of potential risks associated with residual site-related chemicals in the Production, Waste Water Treatment, and Warwick Areas. It is based on analytical results from soil and groundwater samples collected during Phase I and II of the RFI field activities. It was performed by identifying chemicals of potential concern (COPCs) and carrying them through the risk assessment process. The COPCs were determined based on their toxicities, frequencies of detection, concentrations in site soil, and, for inorganics and polycyclic aromatic hydrocarbons (PAHs), comparison to background concentrations.

Regarding potential future land use, unrestricted residential use was assumed for the Warwick Area and Waste Water Treatment Areas. This is considered a "worst-case" since residential land use may not be the most probable for these areas. Based on a proposal to use the Production Area as a

vehicle parking facility, the PHRA reflects an on-site worker scenario for this area. The PHRA also considered the potential human health effects associated with the migration of site-related chemicals, via groundwater, to the Pawtuxet River. Therefore, potential exposure to a canoeist is estimated for each of the three site areas.

Results of the PHRA are expressed in terms of potential noncancer health effects and potential cancer risks which are summarized in Figures 6-1, 6-2, 6-3, and 6-4. The total hazard index (THI) represents the overall estimated noncancer risks for a given exposure scenario. The potential noncancer risk represented by the THI is considered of no significance if it is equal to or below a value of 1, and is a potential concern if it is greater than a value of 1 (rounded to a whole number). The potential cancer risk posed is expressed in terms of an incremental lifetime cancer risk (ILCR). The ILCR is an increased probability of cancer above that which exists as "background" (3 out of 10 people) for the general population. The USEPA regards an ILCR of between 1×10^{-6} (1 in 1,000,000) and 1×10^{-4} (1 in 10,000) as acceptable. Thus, this may be interpreted as an increase in the United States baseline cancer incidence from 300,000 per million population to a range of 300,001 to 300,100 per million population. If the ILCR exceeds the upper bound of the target risk range (1×10^{-4}), then further evaluation or corrective action may be indicated.

As shown in Figures 6-1 and 6-2, neither the Production nor the Waste Water Treatment Area is predicted to pose an unacceptable potential risk. The potential total ILCR and total PCB ILCR slightly exceed the target risk range for the hypothetical resident in the Warwick Area (Figure 6-3), but only because the PCBs are totaled and treated as if they were the carcinogenic PCB 1260. No PCB 1260 was found in the Warwick Area. The risk numbers presented are highly conservative and may exaggerate actual risks due to a number of factors. For example, the sampling approach was biased in that the field investigation targeted highly localized areas of suspected contamination. Additionally, at Region I's request, the total PCB carcinogenic risk is based on the assumption that all PCBs, including those that are noncarcinogenic (e.g. PCB 1248 and 1254) have a cancer potency factor equal to PCB 1260. These factors are especially significant for the Warwick Area, where contamination (PCB 1248 and 1254) is highly localized and no PCB 1260 was detected. Neither was PCB 1260 detected in the Waste Water Treatment Area. From a land-use standpoint, the likelihood of PCB exposure through surface soil is highly unlikely in the Production Area, since the proposed land use is a paved parking facility. The potential human health risks associated with the canoeist scenario are estimated to be nonexistent, with ILCR values less than 3×10^{-8} and THI values less than 0.003 in each of the three Site areas (Figure 6-4).

Even with the high degree of conservatism, the PHRA showed that corrective actions are not necessary for the three site areas solely on the basis of potential risk to public health, with the possible exception of the Warwick Area. However, Ciba volunteered to conduct some limited remediation in these areas to facilitate their productive use. Based on the concentration and frequency of detection in surface soil (the predominant exposure source), it was determined that PCB hot-spot removal in the Production and Warwick Areas would be the most effective action to facilitate their productive use. IRMs have recently been started in the Production and Warwick Areas.

Ecological Risk Assessment

This ecological risk assessment utilizes the risk assessment process as defined by the *Framework for Ecological Risk Assessment* (USEPA, 1992). The objective of this ecological risk assessment is to evaluate potential risks posed to terrestrial receptors by COPCs contained in surface soils (0-2 feet) at the Production and Warwick Areas, and surface soils and seep sediments at the Waste Water Treatment Area.

A terrestrial/riparian reconnaissance survey was conducted at the Site in March, 1992. The terrestrial survey identified twenty-eight species of upland plants and twenty-six species of riparian/wetland plants at and near the Site. Twenty-six species of birds were identified, including: the great blue heron, mallard duck, and red-tailed hawk. Five mammal species were identified, including the Eastern gray squirrel and the raccoon. A seep area in the Waste Water Treatment Area was electroshocked, but no fish were observed. Tadpoles were present in the seep.

Potential exposure pathways for plants and animals include:

- uptake through roots in contact with surface soils,
- foliar uptake of volatilized contaminants,
- consumption (incidental ingestion) of surface soils,
- dermal uptake, and
- ingestion of contaminants which have bioaccumulated into forage or prey items.

The ecological risk assessment is presented in three steps:

Step I--Problem Formulation

Problem formulation is a process which determines the feasibility, scope, and objective of the

assessment. This step identifies the COPCs, the organisms which are representative of the site, the models to be used to determine potential dose from COPCs, and appropriate assessment and measurement endpoints.

Chemical analysis of the surface soils and the toxicity-background concentration screening process resulted in identification of the following:

	Inorganic COPCs	*Organic COPCs*
Production Area	11	44
Warwick Area	14	61
Waste Water Treatment Area	11	54
Seep in the Waste Water Treatment Area	11	31

Representative species were chosen to represent the major trophic levels: a small omnivorous mammal (deer mouse, *Peromyscus* sp.), a large terrestrial omnivore (raccoon, *Procyon lotor*), an aquatic carnivorous bird (great blue heron, *Ardea herodias)* and a carnivorous bird and protected species (red-tailed hawk, *Buteo jamaicensis*). The site, although highly disturbed, has habitat that could be used by each of these organisms. The great blue heron would only possibly use the groundwater seep in the Waste Water Treatment Area. Measurement endpoints for the organisms were chosen as the no-observable-adverse-effect level (NOAEL) for each COPC.

Step II-Exposure Characterization

Models of exposure pathways were developed to estimate daily dose to the representative organisms. These models include direct exposure, as well as bioaccumulation through the food chain.

Step III--Risk Characterization

The risk characterization step quantifies the likelihood of COPCs to cause adverse effects. The toxicity reference values (TRVs), which are equivalent to the NOAELs, are compared to predicted daily doses consumed by each representative species. A toxicity quotient (TQ) is developed that indicates the potential for adverse effects. Assumptions, strengths, weaknesses,

and uncertainties of the analyses are discussed as well as potential ecological significance of any effects.

A COPC is judged to have potential for adverse effects if the TQ is greater than zero. All TQs were less than zero.

Potential cumulative effects were also estimated by calculating an ecological toxicity index (ETI). Index values below one indicate no potential for adverse effect, values between one and ten have some possibility for effect, and probable adverse impact occurs when the ETI exceeds 10.0. The ETI was greater than 1.0 (1.36) only for the deer mouse in the Waste Water Treatment Area. The ETI was below one for all other species in the three Areas.

Potential risk from COPCs in the three areas at the site is small. The TQ for any single chemical is below zero, indicating no potential for adverse effects. The ETI for the Waste Water Treatment Area is only 1.36 for deer mice. Therefore, the ETI indicates no significant risks are expected to the representative species.

Media Protection Standards

Neither the public health nor ecological risk assessment showed that corrective actions are necessary for the three Site areas, with the possible exception of the Warwick Area. The possible exception is one of perception due to the USEPA-imposed assumption that all PCBs are treated as if they were the carcinogenic PCB 1260. No PCB 1260 was detected in the Warwick Area. The PHERE corroborates that the voluntary PCB hot-spot removals begun during the IRMs in the Production and Warwick Areas are more than sufficient to return the Site to productive uses without unacceptable risks to public health and the environment.

The PHRA models for the scenarios evaluated were used to estimate risk-based MPS values for total PCBs in the hot spots targeted for remediation in the IRMs. These MPSs were developed solely for the purposes of the IRMs, and not because of any overriding potential public health or ecological risks. Using a THI value of 1, MPSs were back-calculated through the risk assessment model to the respective surface soil concentrations. The resulting total PCB MPSs are 50 ppm for the Production Area and 5 ppm for the Warwick Area.

6.1 Introduction

A Public Health and Environmental Risk Evaluation (PHERE) was prepared as part of the RFI, as required in the Order. It separately evaluates the potential human health and ecological risks associated with the Production, Waste Water Treatment, and Warwick Areas (Figure 6-5). The PHERE is presented in two parts: the public health risk assessment (PHRA) and the ecological risk assessment. The PHRA is consistent with the approach outlined in the *U. S. Environmental Protection Agency (USEPA) Risk Assessment Guidance for Superfund, Human Health Evaluation Manual* (HHEM) (USEPA, 1989a). The PHRA approach and values for exposure assumptions include those discussed during several meetings and teleconferences with the USEPA Region I (Region I) beginning with a meeting on May 17, 1994. The ecological risk assessment utilizes the assessment process as defined by the *Framework for Ecological Risk Assessment* (USEPA, 1992). The PHERE is prepared in a baseline approach, as directed by the USEPA. This is, the assumption is made that the property will be used in the future without modification from its present condition, regardless of the practicality of this assumption.

6.1.1 Purpose and Scope

The purpose of the PHERE is threefold:

- Provide estimates of potential risks posed by site-related chemicals in the Production, Waste Water Treatment, and Warwick Areas of the Site using the guidance specified by Region I.
- Identify the site areas and chemicals that might require corrective action.
- Provide site-specific risk assessment models for human and ecological health to develop risk-based media protection standards (MPS) for surface soil.

This PHERE is designed to provide a conservative, quantitative estimate of potential risks associated with residual, site-related chemicals in the Production, Waste Water Treatment, and Warwick Areas. It was performed by selecting chemicals of potential concern (COPCs) and carrying them through the risk assessment process consistent with the principals in the USEPA guidance documents. The COPCs were selected based on their toxicities, frequencies of detection, and the concentrations at which they were detected in site soil. Regarding potential future land use, unrestricted residential use was assumed for the Waste Water Treatment and Warwick Areas. The PHERE reflects an on-site worker scenario for the Production Area, based on a proposal to use the Production Area as a vehicle parking facility. The PHERE also

considers the potential human health effects associated with migration of site-related chemicals, via groundwater, to the Pawtuxet River. Potential impacts to aquatic biota will be evaluated in a separate study to be included with submission of the river RFI in March, 1996.

6.1.2 PHERE Organization

Section 6.2 describes the risk assessment methods and chemical analytical data on which the PHERE is based. Section 6.3 describes background soil and groundwater concentrations of chemicals, compares them to on-site concentrations, and defines under what conditions chemicals were separated for further consideration in the PHERE. Section 6.4 presents the PHRA, and Section 6.5 presents the ecological risk assessment. Both assessments address:

- COPC selection process and lists the COPCs for the three site areas.
- Exposure assessment, which includes a description of the exposure setting, potential exposure pathways, potential receptors, chemical intake assumptions, and potential exposure point concentrations.
- Toxicity of the COPCs.
- Risk characterization estimates potential public health and ecological impacts.
- Uncertainties analysis.

MPSs are proposed in Section 6.6. References follow the body of the text in Section 6.7. Tables and figures follow of the text. Appendices 6-A through 6-H provide back-up for the text.

6.2 Risk Assessment Methods and Analytical Data

6.2.1 Risk Assessment Methods

The PHERE was performed following HHEM guidance for the PHRA and the Framework guidance for the ecological risk assessment . This guidance includes appropriate use of the validated data, selection of COPCs, and methods for exposure assessment, toxicity assessment, risk characterization, and uncertainties analysis. The overall site-specific methods were discussed in many meetings and teleconferences with Region 1. Heavy reliance on guidance documents was stressed in these discussions. A partial list of the primary guidance documents and other key sources of information used in the preparation of the PHERE are listed below. Comprehensive detailed methods are given in the text and appendices of the PHERE.

- Integrated Risk Information System (IRIS), Toxicology Data Network, National Library of Medicine, final on-line search performed January, 1995.

- *Health Effects Assessment Summary Tables*, Office of Solid Waste and Emergency Response, Washington, D.C., (EPA/540/R-94/020), USEPA, 1994.

- *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons,* Environmental Criteria and Assessment Office, Cincinnati, Ohio (EPA/600/R-93/089), USEPA, 1993.

- *Dermal Exposure Assessment: Principles and Applications*, Interim Report, Office of Research and Development, Washington, D.C., (EPA/600/8-91/011B), USEPA, 1992.

- *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors*, Interim Final, Office of Solid Waste and Emergency Response, Washington, D.C., (OSWER Directive 9285.6-03), USEPA, 1991.

- *Human Health Evaluation Manual, Part B: Development of Risk-Based Preliminary Remediation Goals*, Office of Solid Waste and Emergency Response, Washington, D.C., (OSWER Directive 9285.7-01B), USEPA, 1991.

- *Exposure Factors Handbook*, Office of Health and Environmental Assessment, Washington, D.C., (EPA/600/8-89/043), USEPA, 1990.

- *"Corrective Action for Solid Waste Management Units (SWMUs) at Hazardous Waste Management Facilities, Proposed Rule,"* 55 *Federal Register* 30798, July 27, 1990 USEPA, 1990.

- *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Part A*, Interim Final, Office of Emergency and Remedial Response, Washington, D.C., (EPA/540/1-89/002), USEPA, 1989.

- Region I guidance for oral absorption and dermal absorption of PCBs, internal memo, based on studies performed by Fries et al., 1989, USEPA, 1995a.

- Region I policy for potential cancer risks related to PCBs, USEPA, 1995b.

- *Framework for Ecological Risk Assessment,* Risk Assessment Forum (EPA/630/R-92/001), USEPA, 1992.

- Ecological Assessment of Superfund Sites: *An Overview, Office of Solid Waste and Emergency Response*, Publication 9345.0-051, USEPA, 1991d.

Other sources of information were used as needed.

6.2.2 Analytical Data

The PHRA is based on analytical results of surface soil, subsurface soil, and groundwater samples provided in electronic database format by Woodward-Clyde Consultants (WCC). These include Phase I and Phase II investigation data. Appendix 6-A provides an evaluation in tabular form of the chemicals detected in soil and groundwater samples from the three on-site areas and the near-site background areas. This evaluation includes their detection frequencies and maximum, minimum, mean, and 95th percentile upper confidence limits (UCLs) of the mean concentrations.

Soil samples were designated by WCC as "surface soil" or "soil boring". The surface soil samples were collected at a depth range of 0.5 to 2.0 feet (or an interval within this range). The

boring samples were collected in 2-foot intervals from the surface using split-spoon samplers. Because the uppermost boring samples were collected at the 0- to 2.0-foot depth, these are included as surface soil samples in the PHRA. The remaining boring samples are referred to in the PHRA as "subsurface soil".

Surface and subsurface soil samples for the Production, Waste Water Treatment, and Warwick Areas were collected in two phases of field investigation, with two rounds of soil sampling in each phase. Phase I-Round 1 soil sampling took place during November and December, 1990; Phase I-Round 2 during March, 1991; Phase II-Round 1 during July and August, 1993; and Phase II-Round 2 during May, 1994. Additional surface soil samples were collected from the Production Area in April 1992; these are included as Phase II-Round 1 samples. Sampling locations and analytical methods are identified and discussed in the *RCRA Facility Investigation Interim Report* (Ciba-Geigy, 1991). The sampling program used a biased approach in that specific locations within Site areas suspected of potential contamination were targeted. This is especially true in the Warwick Area which was not used in the daily operations of the Facility. Therefore, the sampling analytical results are not representative of the entire Warwick Area, but predominantly represent only the highly localized area of SWMU-5 (Figure 6-5). Near-site background soil samples were collected during both rounds of Phase I, and Round 1 of Phase II.

Groundwater samples were collected from background wells (installed hydraulically upgradient of the Site) and from the Production, Waste Water Treatment, and Warwick Areas. Phase I-Round 1 groundwater sampling took place during January 1991; Phase I-Round 2 during April 1991; Phase I-Round 3 during September 1991; Phase II-Round S during August 1992; Phase II-Round 1 during August 1993; and Phase II-Round 2 during April 1994. Samples from each of the three areas were analyzed for USEPA Appendix IX parameters during Phase I-Rounds 1, 2, and 3. Groundwater from the Waste Water Treatment and Warwick Areas was collected and analyzed for Appendix IX parameters during sampling Rounds 1 and 2 of Phase II. Phase II-Round S are groundwater samples collected from the Production Area during investigations to support a stabilization action. These were likewise analyzed for Appendix IX parameters. Phase II-Round 1 and 2 groundwater samples were collected only from the Waste Water Treatment and Warwick Areas.

The acceptable validated data from each of these sampling rounds were used in the PHRA. Data

that were rejected (qualified "R") as a result of the data validation were not included in the PHERE. The data evaluations included in Appendix 6-A are comprised of the following twelve data sets:

- Surface soil for all three Site areas
- Combined surface and subsurface soil ("combined soil") for all three Site areas
- Groundwater for all three Site areas
- Surface water and sediment from the Waste Water Treatment Area seep
- Near-site background surface soil
- Near-site background soil
- Near-site background groundwater

Surface soil and subsurface soil data sets are combined for the soil-to-groundwater transport model used for modeling Pawtuxet River water concentrations, and the soil-to-air transport models used to model volatile emissions in the exposure assessment (Section 6.4.2).

6.2.2.1 Production Area

Production Area soil samples collected during Rounds 1 and 2 of the Phase I investigation were analyzed for the complete list of Appendix IX parameters and indicator compounds, as were some of the samples collected during Round 1 of the Phase II investigation. These came to a total of more than 40 surface soil and 40 subsurface soil samples.

Fifty additional Phase II-Round 1 surface soil samples were collected in April 1992 using a grid sampling pattern. These were analyzed for PCBs only. Only PCB 1248 and PCB 1254 were detected in these samples. The other PCB mixtures were either not detected in these samples or the data were rejected during data validation.

Ten surface soil samples were collected from the Production Area during Phase II-Round 2. Nine of these samples were analyzed for PCBs only; the tenth was analyzed for PCBs and arsenic. The sample analyzed for arsenic was collected from the same sampling location (SF-A13-C27(S)) as was a Phase I-Round 2 sample in which arsenic was detected at a relatively high concentration (125 mg/kg). The Phase II-Round 2 sample collected from this location was analyzed for arsenic to verify the value found in the sample collected during Phase I-Round 2.

Approximately 50 groundwater samples were collected from the Production Area during Phase I-

Rounds 1 through 3, and Phase II-Round S. Most of these were analyzed for the complete list of Appendix IX parameters, although some samples were analyzed for a partial list of these.

6.2.2.2 Waste Water Treatment Area

A total of 21 surface and 13 subsurface soil samples were collected from the Waste Water Treatment Area. Samples collected during Phase I-Rounds 1 and 2, and Phase II-Round 1 were analyzed for the complete list of Appendix IX parameters and indicator compounds. Some of the samples were analyzed for a partial list of these during Phase II. Three additional surface soil samples were collected in Phase II-Round 2 and analyzed for *gamma*-chlordane only.

Twenty-four groundwater samples were collected from the Waste Water Treatment Area during Phase I-Rounds 1 through 3, and Phase II-Rounds 1 and 2. Most of these were analyzed for the complete list of Appendix IX parameters and indicator compounds, although some samples were analyzed for a partial list of these during Phase II.

Sediment and water samples were collected from the groundwater seep in the Wast Water Treatment Area. The analytical results for these samples are summarized in Tables 6-H-9 and 6-H-10.

6.2.2.3 Warwick Area

Surface and subsurface soil samples were collected in the Warwick Area during Phase I and Phase II. Most of these were analyzed for the complete list of Appendix IX parameters, although some samples were limited to a partial list of these. A total of over 30 surface and 20 subsurface soil samples from the Warwick Area were collected for some level of Appendix IX analyses.

Twenty-seven groundwater samples were collected from the Warwick Area during Phase I-Rounds 1 through 3 and Phase II-Rounds 1 and 2. Most of these were analyzed for the complete list of Appendix IX parameters and indicator compounds, although some samples were analyzed for a partial list of these.

6.2.2.4 Background Data

A total of 17 soil samples, 12 surface and 5 subsurface, were collected from background sampling locations. These samples were collected from off-site areas near the Site but not believed to be impacted by the Site. These near-site background soil samples were analyzed for Appendix IX, PCDDs/PCDFs, and indicator compounds. The analytical results of these samples

provide baseline concentrations of the local soils. The background surface soil samples were collected during Rounds 1 and 2 of Phase I, and Round 1 of Phase II. The subsurface background soil samples were collected only during Phase II-Round 1.

Fourteen groundwater samples were collected from upgradient, near-site sampling locations not believed to be impacted by the Site. The analytical results of these samples provide baseline concentrations of chemicals in the local groundwater. These samples were collected during Rounds 1 through 3 of Phase I and Phase II-Round 1, and were analyzed for the complete list of Appendix IX parameters, PCDDs/PCDFs, and indicator compounds.

6.3 On-Site and Background Chemical Concentration Comparison

The purpose of the PHERE is to evaluate the potential risks associated with chemicals related to past Site activities. Although naturally occurring and miscellaneous chemicals originating from human sources not related to Site activities may also pose potential environmental risks, evaluation of risks associated with background soil and groundwater levels of chemicals in this part of Rhode Island is beyond the scope of the PHERE.

Inorganics are ubiquitous in the environment and were found at detectable concentrations in near-site background soils. Therefore, the concentrations of selected inorganics analyzed for in on-site surface and combined soils were compared to those of near-site background surface and combined soils, using a t-test with separate variance. This statistical approach and results are further described in Section 6.3.1

The concentrations of organic compounds in near-site background soils were generally assumed to be zero. However, concentrations of polycyclic aromatic hydrocarbons (PAHs) in near-site background samples were observed to approximate those of the on-site samples. PAHs result from all types of combustion (including that of natural origin) and, like inorganics, are ubiquitous in the environment. Based on site history, PAHs were not used or produced at the Site. Thus, PAH concentrations in on-site soils were compared to near-site background concentrations using the same approach for inorganics. In addition to the statistical t-test approach, on-site and near site detections of PAHs are compared qualitatively in Section 6.3.2.

6.3.1 Statistical Comparisons

Concentration-toxicity screens were performed on each of the on-site media for inorganics and PAHs to determine which are most likely to present the greatest risk to human and ecological health. The approach used for the PHRA was to first list all the inorganics and PAHs separately from the other detected compounds. The screening method described in Appendix 6-B was performed on these inorganics and PAHs. Briefly, this screening involved running *t*-tests on the inorganics and PAHs identified as the greatest contributors to relative ranking scores (relative to all inorganics and PAHs). The *t*-tests were used to determine whether the on-site concentrations were greater than those found in near-site background soils. The subset of inorganics and PAHs shown by the *t*-tests to be at higher concentrations in the on-site soil than in the near-site background soil were assumed to be site-related and the contribution of background to the total

detected concentrations were not subtracted out. These inorganics and PAHs were added to the list of other organic compounds and carried into the next step of the risk assessment process as described in Appendix 6-B. The potential risks of the selected inorganics and PAHs statistically found to be at background concentrations were assessed separately (See Section 6.4.4).

The methods used to assess potential risks posed to ecological receptors differ from those used in human health risk assessment. Therefore, a somewhat different approach was used to select the inorganics and PAHs in the on-site soils that were statistically tested against background. The inorganics and PAHs representing the greatest potential ecological risks on Site, based on toxicity quotients, were analyzed statistically using the *t*-test (See Section 6.5). Those exceeding background were included in the ecological risk assessment. Also, the PAHs and inorganics not selected for statistical comparison were included in the ecological risk assessment without regard to their concentrations relative to background.

The following is the complete list of inorganics and PAHs whose concentrations in the three Site area soils were compared to those of near-site background soils:

Production Area

Arsenic	Barium	Benzo(a)pyrene
Chromium	Dibenz(a,h)anthracene	Nickel
Vanadium		

Waste Water Treatment Area

Arsenic	Benzo(a)anthracene	Benzo(a)pyrene
Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene
Beryllium	Chromium	Chrysene
Dibenz(a,h)anthracene	Indeno(1,2,3-c,d)pyrene	Manganese
Vanadium		

Warwick Area		
Antimony	Arsenic	Beryllium
Benzo(a)pyrene	Cadmium	Chromium
Manganese	Zinc	

The *t*-test results are summarized below:

Production Area:

- Nickel is the only selected inorganic or PAH that tested to be significantly above background concentrations. Nickel was found to be above background in combined soils only.

Waste Water Treatment Area:

- No selected inorganic or PAH was found to be present in surface or combined soil at concentrations greater than those found in near-site background soil.

Warwick Area:

- Five of the selected inorganics were determined to be present in surface and combined soils at concentrations significantly above background. These are:
  - -antimony,
  - -beryllium,
  - -cadmium,
  - -chromium, and
  - -zinc.

  Antimony could not be tested statistically because all of the background soil data for antimony were rejected during data validation. Therefore, we assume that it was present in Warwick Area soils at above-background concentrations. None of the PAHs were found to present at concentrations greater than near-site background.

On-site soil represents the source for site-related groundwater contamination. Therefore, if a given inorganic or PAH was not statistically greater in concentration than in background soil, then the presence of that chemical in groundwater was assumed to be unrelated to the Site.

6.3.2 Qualitative Comparison of PAHs

As seen in Section 6.3.1, no PAH was detected significantly above background concentrations in any of the three site areas. A qualitative comparison was also performed to better determine whether PAHs found in on-site soils are likely to be of similar origin as those detected in near-site background soils.

The PAHs were detected at higher concentrations and at greater frequencies in both on-site and near-site background surface soils than in subsurface soils. Since potential exposure at the Site is predominantly associated with surface soil (Sections 6.4.2 and 6.5.3), and PAHs are of low volatility and mobility in soil matrices, only surface soil samples were included in this comparison.

The following subsections describe qualitative comparisons of Production, Waste Water Treatment, and Warwick Areas surface soil concentrations of PAHs to those of near-site background samples. PAHs are discussed with respect to both total PAHs and benzo(a)pyrene. Benzo(a)pyrene was selected for particular discussion because it is regarded (along with dibenz(a,h)anthracene) as being among the most potent PAH animal carcinogens, and it is one of the more commonly detected PAHs in on-site and near-site soils. Data relating to on-site and near-site surface soil concentrations of each detected PAH compound and total PAHs are summarized in Tables 6-1 through 6-3. Concentrations available from literature sources of the individual PAHs found in urban soils are also shown in these tables.

6.3.2.1 Production Area

6.3.2.1.1 Total PAHs

Seventeen PAHs were detected in Production Area surface soil, as well as in the near-site background soil. Generally, the frequencies of detection are slightly greater in the background samples than in the Production Area samples (Table 6-1). Six PAHs were detected in the two sample sets at virtually the same frequency, ten were more frequently detected in the background samples, and only benzo(a)anthracene was more frequently detected in the Production Area samples. The two data sets are strikingly similar with regard to those of the 17 PAHs most frequently and least frequently detected. This is illustrated below (frequencies of detection are shown in parentheses):

Most Frequently Detected:

Frequency Rank	Production Area	Frequency Rank	Background
1	Fluoranthene (81%)	1	Fluroanthene (100%)
2	Pyrene (78%)	1	Pyrene (100%)
3	Benzo(b)fluoranthene (73%)	3	Phenanthrene (92%)
4	Chrysene (68%)	4	Chrysene (75%)
4	Phenanthrene (68%)	4	Benzo(b)fluoranthene (75%)

Least Frequently Detected:

Frequency Rank	Production Area	Frequency Rank	Background
17	2-Methylnaphthalene (9.8%)	17	2-Methylnaphthalene (17%)
16	Acenaphthene (12%)	16	Dibenz(a,h)anthracene (25%)
14	Dibenz(a,h)anthracene (24%)	14	Naphthalene (33%)
14	Acenaphthylene (24%)	14	Acenaphthylene (33%)

The five most commonly detected PAHs in Production Area surface soil are also the five most frequently detected in near-site background surface soil. Likewise, three of the four least frequently detected PAHs in the background surface soil are also three of the four least frequently detected in Production Area surface soil. The nearly identical relative concentrations of PAHs detected in on-site and near-site soils strongly suggest that PAHs detected in the Production Area and near-site areas originate from off-site sources unrelated to Site activities. The analytical results discussed above also indicate that PAHs are found ubiquitously in this urban region of Rhode Island. The mean concentration of total PAHs in the Production Area surface soil samples (22 mg/kg) is less than that of total PAHs in near-site background samples (48 mg/kg), as shown in Table 6-1.

Table 6-1 also lists background concentrations of PAHs in urban soil that are published in the literature. None of the mean or UCL of the mean concentrations exceed these ranges, and are considerably less than the maximum values of the ranges given. This indicates that the PAH concentrations of Production Area and near-site background surface soil may be lower than is typical for an urban setting.

6.3.2.1.2 Benzo(a)pyrene

Benzo(a)pyrene was detected at virtually the same frequencies in Production Area (66%) and near-site background surface soil (67%) (refer to Table 6-1). The mean concentration (1.3 mg/kg) found in Production Area surface soil samples is less than the mean concentration (2.6 mg/kg) detected in the background soil samples. White and Vanderslice (1980) list a typical range of 50 to 75 mg/kg for benzo(a)pyrene in urban soil. The concentrations of benzo(a)pyrene detected in both Production Area and near-site background soil are below this range.

It should be noted that the mean concentration for benzo(a)pyrene found in near-site background soil is skewed higher due to one surface soil sample in which this compound was detected at 22 mg/kg. However, even this value is low in comparison to the typical soil concentration range for benzo(a)pyrene (50 to 75 mg/kg) described in the literature.

6.3.2.2 Waste Water Treatment Area

6.3.2.2.1 Total PAHs

Sixteen PAHs were detected in Waste Water Treatment Area surface soil. These 16 PAHs were likewise detected in the near-site background soil (Table 6-2). The detection frequency of these 16 compounds (including 2-methylnaphthalene) is greater in background than in Waste Water Treatment Area surface soil. Only naphthalene was found to have a greater detection frequency in the Waste Water Treatment Area (50%) than in the near-site background surface soil (33%). Relative detection frequencies of PAHs within the Waste Water Treatment Area soil data set mirror those of the near-site background data set. This observation was also made for the Production Area (Section 6.3.2.1). The individual PAHs detected most and least frequently in the two data sets are listed below in order of rank with respect to frequency of detection (frequencies of detection are shown in parentheses):

Most Frequently Detected:

Frequency Rank	Waste Water Treatment	Frequency Rank	Background
1	Pyrene (89%)	1	Pyrene (100%)
2	Phenanthrene (78%)	1	Fluoranthene (100%)
3	Fluoranthene (67%)	3	Phenanthrene (92%)

Least Frequently Detected:

Frequency Rank	Waste Water Treatment Area	Frequency Rank	Background
17	2-Methylnaphthalene (0%)	17	2-Methylnaphthalene (17%)
14	Dibenz(a,h)anthracene (5.6%)	16	Dibenz(a,h)anthracene (25%)
14	Acenaphthylene (5.6%)	14	Acenaphthylene (33%)
14	Acenaphthane (5.6%)	14	Naphthalene (33%)

The three most frequently detected PAHs in Waste Water Treatment Area surface soil are the same as the three detected most frequently in the near-site background surface soil. Likewise, three of the four least frequently detected PAHs in Waste Water Treatment Area surface soil are the same as those detected in background soil. Just as for the Production Area (Section 6.3.2.1), the nearly identical relative concentrations of PAHs detected in on-site and near-site soils strongly suggest that PAHs detected in the Waste Water Treatment Area and near-site areas originate from off-site sources unrelated to Site activities. The analytical results discussed above also indicate that PAHs are found ubiquitously in this urban region of Rhode Island. The mean concentration of total PAHs in Waste Water Treatment Area surface soil samples (14 mg/kg) is less than that of total PAHs in near-site background surface soil samples (48 mg/kg), as shown in Table 6-2.

Table 6-2 also lists background concentrations of PAHs in urban soil that are published in the literature. None of the mean or UCL of the mean concentrations exceed these ranges, and are considerably less than the maximum values of the ranges given. This indicates that the PAH concentrations of Waste Water Treatment Area and near-site background soil may be lower than is typical for an urban setting.

6.3.2.2.2 Benzo(a)pyrene

Benzo(a)pyrene was detected at a lower frequency in Waste Water Treatment Area surface soil (28%) than in near-site background surface soil (67%) (see Table 6-2). The mean concentration (0.86 mg/kg) found in Waste Water Treatment Area surface soil samples is less than the mean concentration (2.6 mg/kg) detected in the background soil samples. White and Vanderslice (1980) list a typical range of 50 to 75 mg/kg for benzo(a)pyrene in urban soil. The concentrations of benzo(a)pyrene detected in both Waste Water Treatment Area and near-site background soil are below this range.

6.3.2.3 *Warwick Area*

6.3.2.3.1 *Total PAHs*

Seventeen PAHs were detected in Warwick Area surface soil, as well as in the near-site background soil (Table 6-3). The detection frequency for each compound is greater in background than in Warwick Area surface soil. Relative detection frequencies of PAHs within the Warwick Area soil data set mirror those of the near-site background data set. This observation was also made for the Production and Waste Water Treatment Areas (Section 6.3.2.1 and 6.3.2.2). The individual PAHs detected most and least frequently in the two data sets are listed below in order of rank with respect to frequency of detection (frequencies of detection are shown in parentheses):

Most Frequently Detected:

Frequency Rank	Warwick Area	Frequency Rank	Background
1	Pyrene (58%)	1	Pyrene (100%)
2	Fluoranthene (55%)	1	Fluoranthene (100%)
2	Phenanthrene (55%)	2	Phenanthrene (92%)

Least Frequently Detected:

Frequency Rank	Warwick Area	Frequency Rank	Background
15	Acenaphthene (9.7%)	17	2-Methylnaphthalene (17%)
15	Dibenz(a,h)anthracene (9.7%)	16	Dibenz(a,h)anthracene (25%)
15	Acenaphthylene (9.7%)	14	Acenaphthylene (33%)
14	2-Methylnaphthalene (19%)	14	Naphthalene (33%)

The three most frequently detected PAHs in Warwick Area surface soil are the same, in order, as the three detected most frequently in the near-site background surface soil. Likewise, three of the four least frequently detected PAHs in Warwick Area surface soil are the same as those detected in background soil. Just as for the Production and Waste Water Treatment Areas (Section 6.3.2.1 and 6.3.2.2), the nearly identical relative concentrations of PAHs detected in on-site and near-site soils strongly suggest that PAHs detected in the Warwick Area and near-site areas originate from off-site sources unrelated to Site activities. The analytical results discussed above also indicate

that PAHs are found ubiquitously in this urban region of Rhode Island. The mean concentration of total PAHs in Warwick Area surface soil samples (21 mg/kg) is less than that of total PAHs in near-site background samples (48 mg/kg), as shown in Table 6-3.

Table 6-3 also lists background concentrations of PAHs in urban soil that are published in the literature. None of the mean or UCL of the mean concentrations exceed these ranges, and are considerably less than the maximum values of the ranges given. This indicates that the PAH concentrations of Warwick Area and near-site background soil may be lower than is typical for an urban setting.

6.3.2.3.2 Benzo(a)pyrene

Benzo(a)pyrene was detected at a lower frequency in Warwick Area surface soil (42%) than in near-site background surface soil (67%) (see Table 6-3). The mean concentration (1.2 mg/kg) found in Warwick Area surface soil samples is less than the mean concentration (2.6 mg/kg) detected in the background soil samples. White and Vanderslice (1980) list a typical range of 50 to 75 mg/kg for benzo(a)pyrene in urban soil. The concentrations of benzo(a)pyrene detected in both Warwick Area and near-site background soil are below this range.

6.4 Public Health Risk Assessment

6.4.1 Chemicals of Potential Concern

The COPCs were selected using a screening process based on HHEM guidance and detailed in Appendix 6-B. Detected concentrations, frequencies of detection, and toxicities were considered during screening. Comparisons to background concentrations regarding inorganics and PAHs is described in Section 6.3. PAHs and certain inorganics were previously removed from the selection process discussed here and detailed in Appendix 6-B. The purpose of using the screening process was to limit the PHRA to the COPCs in each Site area which represent the majority of human health risks. Separate COPCs were selected for cancer and noncancer risks. These COPCs were carried through the risk assessment process.

The COPCs for the respective areas and the basis for their selection (*) regarding cancer or noncancer effects are listed below:

PRODUCTION AREA

Cancer Effects	*Noncancer Effects*
PCB 1260*	PCB 1248*
gamma-Chlordane*	PCB 1254*
Vinyl chloride*	*gamma*-Chlordane
Total PCBs	2-Nitroaniline*
	Chlorobenzene*
	Toluene*

WASTE WATER TREATMENT AREA

Cancer Effects	*Noncancer Effects*
2,3,7,8-TCDF*	PCB 1254*
Dieldrin*	*gamma*-Chlordane*
bis(2-Ethylhexyl)phthalate*	Tinuvin 327*
gamma-Chlordane	Dieldrin
Total PCBs	*bis*(2-Ethylhexyl)phthalate*

WARWICK AREA

Cancer Effects	*Noncancer Effects*
Aldrin*	PCB 1248*
Beryllium*	PCB 1254*
Dieldrin*	2-Nitroaniline*
bis(2-Chloroethyl)ether*	Chlorobenzene*
Total PCBs	Aldrin
	Beryllium
	Dieldrin

Toxicity information for the COPCs is presented in Section 6.4.3.

6.4.2 Exposure Assessment

The exposure assessment is a critical component of the human health risk assessment. Exposure assessment methodologies used in the PHRA and the resulting estimated potential exposures are presented in detail in Appendix 6-C. With respect to chemical hazards, exposure may be defined as the contact of an individual with a chemical agent. Exposure itself does not connote risk, but without exposure or potential exposure a chemical agent poses no risk.

Exposure assessment in human health risk assessment is used to estimate the quantity of a given chemical that could cross the exchange boundaries between the environment and the body. These boundaries are generally at the gastrointestinal tract, the lungs, and the skin. But before an estimation may be made regarding the quantity of exposure, appropriate scenarios must be developed under which exposure could potentially occur.

The basic steps of an exposure assessment are to:

- characterize the exposure setting;
- identify potential exposure pathways;
- identify human receptors;
- develop exposure scenarios;
- develop exposure models; and
- quantify exposure.

The exposure setting consists of the physical environment, including the proximity of the site to current human populations. The identification of potential exposure pathways considers the characterization of the exposure setting, impacted environmental media, and medium-to-medium transport. The identification of human receptors includes both current and future populations identified during the characterization of the exposure setting. Potential future land uses are evaluated to identify potential future human receptors. The associated routes of exposure for an identified receptor population is referred to as an exposure scenario. Exposure scenarios are developed based on the receptors and potential exposure pathways. Determinations are made regarding which routes of exposure are appropriate for inclusion in the exposure assessment for each identified potential human receptor population.

Exposure quantification uses information from the previous exposure assessment steps. Exposure equations are used to quantify exposure associated with each selected pathway in the exposure scenario, and these comprise the exposure models. Variables used in the exposure equations include, among others, measured concentrations of chemical in the media, contact rates with the media, frequency of exposure, exposure duration per exposure event, body weight of the exposed individual, total duration over which an individual is exposed, and the time period over which the exposure is averaged. Most of these input variables are site-, medium-, and receptor-specific and may include measured, modeled, or default values. However, they are also chemical specific, relying on factors that influence concentration.

6.4.2.1 Exposure Setting

This section describes features of the Site and its location as they apply to human health risk assessment. A detailed site description is given in the RFI Report.

The Site is located along the Pawtuxet River in Cranston, Rhode Island. The climate may be characterized as temperate with four well-defined seasons, and is heavily influenced by Narragansett Bay and the Atlantic Ocean. The mean annual temperature is approximately 50°F, with a daily mean during the coldest month (January) of 29°F and the warmest month (July) of 73°F. The mean annual number of freezing days (minimum temperature of 32°F or less) is 114. The average annual rainfall is approximately 42 inches per year. Measurable precipitation (0.01 inches of rain equivalence) averages 124 days annually and is typically distributed evenly throughout the year. The annual snowfall averages approximately 36 inches, over half of which usually falls during January and February. The wind blows most commonly from a northwestern direction and least commonly from an eastern direction. The average annual wind speed is 11

miles per hour. Meteorological data are from the weather station in Providence, Rhode Island and are contained in Volume 1 of the *RCRA Facility Investigation Proposal* (Ciba, 1990). Additional data are from the National Oceanic and Atmospheric Administration (1990).

The Production and Waste Water Treatment Areas are located on the north shore of the Pawtuxet River in Cranston; the Warwick Area is on the south shore of the Pawtuxet River and is in Warwick, Rhode Island (Figure 6-5). Areas surrounding the Site are used for commercial, industrial, or residential purposes. The area west of the Production Area is industrial; areas north and east of the Production Area are residential. Based on different levels of impact and probable future land use, the Production Area, as defined in the Consent Order with the USEPA, is for the purpose of the PHRA divided into two parcels: the Laboratory and Warehouse Building Area and the Production Area. These are identified on Figure 6-1. Virtually no site-related chemicals were found in the Laboratory and Warehouse Building Area, thus it was not evaluated further in the RFI. Therefore, only the risks associated with the Production Area identified on Figure 6-5 are evaluated in the PHRA.

The Warwick Area is bordered by land in commercial use to the east and residential use to the south. The river lies north and west of this area. The areas west and north of the Waste Water Treatment Area are residential, and the land east of this area is currently used for commercial purposes.

6.4.2.2 Potential Exposure Pathways and Human Receptors

An exposure pathway may be defined as a course that a chemical may take from a source of contamination to an individual. The following four elements are necessary for an exposure pathway to be complete:

- Contamination source and release mechanism;
- Retention medium or transport medium;
- Point of potential human contact with the impacted medium; and
- Human exposure route at the contact point.

The sources and release mechanisms involve previous chemical manufacturing, chemical handling, and waste handling and disposal activities which have occurred in the Site areas. Impacted media which may serve to retain and/or release the contamination are surface soils, subsurface soils, and groundwater. Points of human contact with the impacted media are dependent on land use.

One purpose of the PHRA is to provide conservative estimates of risk. On-site residential use would represent a "worst-case" land use. Ciba has assumed for risk assessment purposes that future on-site residential risk ought to be evaluated for the Warwick and Waste Water Treatment Areas. Although residential land use may not be the most probable for this area, to be conservative the PHRA evaluates this land use. On-site occupational exposure is assumed for the Production Area because it is being proposed for use by the City of Cranston as parking for city vehicles, and as a storage and loading area for road salt, sand, and snow removal equipment. An on-site worker will potentially occupy this area full-time, but only during the four coldest months of the year performing activities related to snow and ice management of City streets. Parking and vehicle removal by a wide array of City employees will be the only activity for the other 8 months of the year (City of Cranston, 1995). Vehicle maintenance will be conducted within the buildings. A nonspecific commercial/industrial worker scenario which does not consider the planned use of the Site by the City is also evaluated.

6.4.2.2.1 On-Site Worker Scenario/On-Site Resident Scenario

The on-site worker scenario for the Production Area, and the on-site resident scenario for the Waste Water Treatment and Warwick Areas are evaluated assuming that no modifications are made to the property, such as soil removal or bringing in clean topsoil. The media that may affect a future on-site resident or on-site worker include surface and subsurface soils. Exposure pathways associated with these scenarios are:

- Direct contact with surface soil resulting in incidental ingestion;
- Direct contact with surface soil resulting in dermal absorption;
- Inhalation of airborne chemicals associated with fugitive dust emissions from surface soil; and
- Inhalation of volatilized chemicals associated with surface and subsurface soil.

It is not reasonable to assume that groundwater from the shallow aquifer underlying the vicinity of the Site will be used as drinking water. Groundwater beneath the Site is classified by RIDEM as GB. It is not suitable for public or private drinking water use and is typical of highly urbanized areas with dense concentrations of industrial and commercial activities. This classification is also used for groundwater underlying permanent waste disposal areas (such as landfills). There are no private wells in the vicinity of the site. Because of the limited areal extent of groundwater contamination at the Site, and because the contaminated groundwater discharges directly to the Pawtuxet River, the river pathway for groundwater is the only potential exposure route. In addition, virtually no site-related contamination was found in deeper aquifers.

Site-related chemicals were detected only in shallow groundwater, which follows a strong gradient toward the Pawtuxet River bordering the Production Area. A RCRA Stabilization Action is addressing this groundwater in the Production Area.

Figure 6-6 illustrates the exposure pathways evaluated in the PHRA for these exposure scenarios. Values for the exposure assumptions for these two scenarios are shown in Table 6-4.

6.4.2.2.2 Canoeist Scenario

Because groundwater underlying the Site will not be used for drinking water, a canoeist scenario was developed for each of the Site areas to evaluate the potential risk of impacted groundwater to the human receptor most likely to be in maximum contact with this medium. Potential ingestion of fish will be addressed in the Pawtuxet River RFI. Groundwater contact with regard to the canoeist scenario would be indirect; actual exposure would be to Pawtuxet River water to which groundwater underlying the Site has discharged. Predicted river water concentrations of COPCs were modeled by WCC for each of the three Site areas. The model uses measured groundwater and soil concentrations of the COPCs, as described in Appendix 6-D, to predict Pawtuxet River water concentrations.

Figure 6-6 illustrates the exposure pathways evaluated in the PHRA for this exposure scenario. Values for the exposure assumptions for the canoeist scenario are shown in Table 6-5.

6.4.2.3 Potential Exposure Point Soil Concentrations

The COPC concentrations for the environmental media pertinent to the exposure assessment are shown for the three Site areas in Table 6-6. The concentrations given for surface soils and combined surface and subsurface soils were derived from direct measurements (Appendix 6-A). Air concentrations shown on Table 6-6 are predicted from measured surface soil and combined soil concentrations using the modeling procedures described in Appendix 6-D.

Concentrations of COPCs for these soils are the lesser of either the 95th percentile UCL of the means or the maximum detected concentrations. For compounds detected in one or more surface soil samples from a given Site area, the 95th percentile UCLs of the arithmetic means were calculated using the detected value, or one-half the sample quantitation limit (SQL) for samples in which the chemical was not detected. The methods for determining statistical distribution type and calculating the 95th percentile UCL of the mean are described in Section 6.4.2.3.2. The surface soil values in Table 6-6 were used in the soil ingestion and dermal absorption exposures

estimated for the on-site resident and worker scenarios (Appendix 6-C) . They were also used in the inhalation pathway exposure estimates of fugitive dust (Appendix 6-D). The values shown in Table 6-5 for combined subsurface and surface soil concentrations were used for estimating exposure to chemical vapors (Appendix 6-D), and for modeling soil-to-groundwater concentrations (Appendix 6-E).

6.4.2.3.1 Total PCBs Data Sets

Region I policy is to assume that all PCBs have the same cancer potency as PCB 1260 (see Sections 6.4.3 and 6.4.4) (USEPA, 1995b). However, soil samples are analyzed and concentrations reported for the separate PCB mixtures. Thus, to assess the potential risks of total PCBs as requested by Region I, the analytical results of all the PCBs detected within a medium were combined to form a separate data set for that medium. For example, three PCBs were detected in Production Area surface soil. The concentrations of PCB 1248, PCB 1254, and PCB 1260 were summed for each Production Area surface soil sample. For samples in which a given PCB was not detected, one-half the sample quantitation limit (SQL) was used. This same approach was taken for Warwick Area surface soil, except that only PCB 1248 and PCB 1254 were summed because neither PCB 1260 nor any other PCB was detected in any Warwick Area surface soil sample. The 95th percentile UCL of the mean was used as the exposure point concentration, just as for the data sets of the respective COPCs.

The combined surface soil and subsurface soil data sets are used in the PHRA only for the soil-to-air volatilization model and the soil-to-groundwater-to-surface water model. Because different volatilization rates have been modeled for the individual PCBs, the modeled gaseous concentrations of the separate PCBs were summed to derive an overall exposure to total PCBs with regard to this exposure pathway. The total PCBs surface water concentration is estimated from summing the modeled values of the individual PCBs.

6.4.2.3.2 Statistical Distribution of Chemicals in Soil

Statistical analyses were performed to determine the type of distribution represented by each COPCs detected in soil. The type of statistical distribution of the chemical analytical data should be identified, if possible, for a more meaningful exposure point concentration estimate. If a given analyte is detected in too few soil samples, then the type of statistical distribution of the analyte in the soil cannot be reliably ascertained. As described in Section 6.4.1, if a chemical is not detected in a given sample, then one-half the SQL is the assumed concentration. These one-half SQL values do not accurately portray the actual concentrations, but are used expressly for

exposure assessment purposes. This is particularly true if SQL values of the nondetected samples are high relative to the detected values in a data set. The statistical methods and description of the general procedures used in the PHRA to determine distribution type are described in the following paragraphs.

Each data set was first evaluated for frequency of detection. The PHRA uses a lower limit detection frequency of 75% to determine whether a data set can be statistically tested to evaluate its distribution. Data sets with detection frequencies greater than 75% were evaluated using the Shapiro-Wilk *W*-test for normality. If the data set meets the test criteria for normality at $p<0.05$, then the chemical is assumed to be normally distributed over the given Site area, and the 95th percentile UCL of the arithmetic mean based on a normal distribution was used to estimate the exposure point concentration. If the data set fails the test for normality, then a Shapiro-Wilk *W*-test for lognormality was performed. If the data set meets the criteria for lognormality, then the chemical was assumed to be lognormally distributed over the given Site area, and the 95th percentile UCL of the arithmetic mean concentration based on a lognormal distribution was used to estimate the exposure point concentration. If a data set meets the criteria for neither statistical distribution, then distribution was assumed to be normally distributed for purposes of calculating the 95th percentile UCL of the mean.

6.4.2.4 Potential Exposure Point Pawtuxet River Water Concentrations

The approach used to estimate exposure point concentrations for the Pawtuxet River is similar to that used for the estimation of potential exposure point soil concentrations (Section 6.4.2.3). The lesser of either the highest detected concentration or the 95th percentile UCLs of the groundwater and of combined soil and subsurface soil concentrations were used as input values to predict river water concentrations of the COPCs associated with each of the Site areas (Appendix 6-E). Groundwater concentrations were predicted from the combined soil values using leaching and infiltration assumptions. For each COPC in each Site area, the greater of either the predicted groundwater concentration or the value based on measured groundwater concentrations were used to predict water concentrations in the Pawtuxet River based on groundwater discharge from each Site area. Two modeling scenarios were assumed: a low flow/low distribution coefficient scenario and a high flow/high distribution coefficient scenario. The latter scenario was selected for the PHRA exposure calculations because the modeled chlorobenzene concentration under this scenario (1 ug/l) is similar to those measured over a six-month monitoring period in the Site area of the Pawtuxet River. Chlorobenzene is the only COPC for which this type of monitoring data of the river is available.

6.4.2.5 Exposure Assessment Results

The calculated potential exposures are determined by a number of exposure assumptions and variables for each scenario. Methods for calculating exposure are presented in Appendix 6-C. Input values for calculating exposure are shown in Table 6-4 for the on-site resident and on-site worker scenarios, and in Table 6-6 for the canoeist scenario. The exposure assessment results, given in Appendix 6-C, are carried into the risk characterization.

6.4.3 Toxicity Assessment

Toxicity assessment consists of identifying and evaluating toxicity criteria and health effects information for the chemicals detected in impacted and/or potentially impacted media. In the PHRA, toxicity criteria were identified during the COPC screening process (Appendix 6-B). Attention is given to the relationship between the level of the exposure and the severity of any resultant adverse health effects. Specific adverse health effects are noted for each chemical carried through the risk assessment process, particularly those effects on which the toxicity criteria are based. Information obtained during the toxicity assessment is used in the risk characterization (Section 6.4.4) to estimate risks associated with the exposure levels estimated during the exposure assessment (Section 6.4.2).

Toxicity information for the COPCs and background compounds is shown in Table 6-7 and the full Integrated Risk Information System (IRIS) print-outs are given in Appendix 6-F. This information includes the following:

- Chronic reference doses (RfDs);
- Cancer slope factors (CSFs);
- Target organs for adverse health effects;
- Tumor sites; and
- USEPA weight-of-evidence classification system for cancer effects.

The items listed above are described in the following subsections.

6.4.3.1 Health Effects Classification

Chemicals may exhibit a variety of adverse health effects. For risk assessment purposes, these adverse effects are generally divided into two categories: noncancer and cancer. The reason for this distinction is the opinion that the mechanism for each is different. It is generally believed that the body has protective mechanisms against most noncancer effects. These defenses must be overcome by a given exposure level of a toxicant before any adverse effects occur. Therefore, it

is thought that a range of exposure levels from zero to some finite threshold level can be tolerated with essentially no risk of adverse health effects.

Unlike noncancer effects, cancer is assumed by USEPA in most cases not to have a threshold level (USEPA, 1989a). The hypothesized mechanism of carcinogenesis assumes that there is essentially no level of exposure to a carcinogen that does not pose a finite probability, however small, of generating a carcinogenic response.

The USEPA-preferred and most regularly updated source of toxicity information is the (IRIS) on-line data base. IRIS was the primary source of health effects criteria used in this toxicity assessment, and IRIS toxicity profiles are included as Appendix 6-F. When health effects criteria were not found in IRIS, this information was sought in the Health Effects Assessment Summary Tables (HEAST-USEPA, 1994), the agency's second preference. Other sources of toxicity information were used only when the health effects criteria were not available in IRIS or HEAST. Health effects criteria for noncancer effects and cancer effects are discussed in Sections 6.4.3.2 and 6.4.3.3, respectively. A given chemical may exhibit both noncancer and cancer effects.

6.4.3.2 Health Criteria for Noncancer Effects

The assessment of toxic effects for a noncarcinogenic chemical is based on the RfD approach. An RfD is a daily human oral intake level measured in milligrams of chemical per kilogram of body weight (mg/kg-day), such that a lifetime of exposure to a given toxicant at the RfD level theoretically poses virtually no risk of deleterious effects (USEPA, 1989a). It is developed or verified by USEPA's RfD/RfC Work Group using oral toxicity data. Reference concentrations (RfCs) are developed or verified for inhalation also by USEPA's RfD/RfC Work Group. An RfC is a daily human inhalation intake based on a constant lifetime average concentration of a chemical in air, measured in milligrams of chemical per cubic meter of air (mg/m^3). Likewise, they are derived from toxicity data to be within a tolerable threshold level that poses virtually no risk of deleterious health effects. RfCs may be converted to RfDs using exposure assessment calculations. Note that in Table 6-7, inhalation route RfDs are referred to as "RfD_is". RfDs are also used for the dermal absorption route of exposure. Chemical-specific differences of absorption via the oral and dermal routes are addressed separately in the exposure assessment (Section 6.4.2 and Appendix 6-C).

Even though RfDs are designed to be below threshold health effects levels using conservative

assumptions, it cannot be definitively stated that a given level of exposure below the RfD poses no risk. Neither can it be assumed that a given exposure level above the RfD poses a definite human health risk. The most sensitive subpopulations are considered in establishing RfDs.

An RfD is derived from human studies that provide some quantification of exposure or from animal studies. If available, a no-observed-adverse-effects level (NOAEL) is used. Uncertainty factors, typically of an order of magnitude each, may be used to account for the following:

- Variations in sensitivity among the exposed population;
- Extrapolations from animal studies to human exposures;
- Extrapolations from shorter term studies to chronic exposures; and
- Extrapolations from a lowest-observed-adverse-effects level (LOAEL) to a NOAEL.

An additional uncertainty or modifying factor is used to reflect professional judgement of the uncertainties of the study and the database not explicitly addressed by the above factors. The modifying factor may range from one to less than ten. When combined, these uncertainty factors may result in a nearly 100,000-fold margin of safety with respect to the toxicity criteria. Therefore, an RfD or RfC is biased in overestimating the possibility of toxic effects from exposure to a chemical.

6.4.3.2.1 RfD for PCB 1248

PCB 1248 has no USEPA-established reference dose (RfD), so it was necessary to derive a provisional RfD. PCB 1248 elicits both developmental and immunologic effects, with developmental appearing to be the critical effect. A provisional PCB 1248 RfD of 8×10^{-5} mg/kg-day was derived for developmental effects (Table 6-7), and a provisional RfD of 1×10^{-3} mg/kg-day for immunologic effects was also derived. Because of potential additive toxicity with PCB 1254, immunologic effects of PCB 1248 are relevant to the PHRA. A detailed discussion of how these provisional RfDs were developed is given in the following subsections.

6.4.3.2.1.1 Developmental Effects

In addition to IRIS, the Hazardous Substances Data Bank (HSDB), Registry of Toxic Effects of Chemical Substances (RTECS), Developmental and Reproductive Toxicology Database (DART), and TOXLINE on-line databases were searched for toxicity information on PCB 1248. The journal articles referenced in these databases were reviewed. As mentioned above, the

critical effect that occurs at the lowest dose is a developmental effect. In the key study (Allen et al., 1979) adult female rhesus monkeys (eight per exposure level) were fed PCB 1248 at estimated doses of 0.008 and 0.016 mg/kg-day for 18 months. After seven months of exposure, the primates were bred and the mothers and offspring evaluated for toxic effects. Six of eight conceptions at the lower exposure level, and seven of eight at the higher level resulted in live births, and the infants survived the experimental period. No maternal toxicity was observed at either dose level, but the infants were somewhat smaller than controls at birth. These infants gained less weight than controls during the nursing period, and they developed focal areas of skin hyperpigmentation. These are some of the classic signs of PCB intoxication. A PCB 1248 RfD of 8×10^{-5} mg/kg-day for people is estimated using the following uncertainty factors:

Extrapolation from a lowest-observed adverse effect level to a NOAEL = 10

- The standard default value was used because several of the 16 female rhesus monkeys in the combined 0.008 and 0.016 mg/kg-day dose groups (all of which conceived) had resorptions/abortions (Allen et al., 1979). Unfortunately, the reproductive performance of the control group is not specified. Reproductive performance in rhesus monkeys is highly variable among colonies, but 25 to 35% fetal losses in pregnant females is common. However, other publications by this group of investigators report no fetal losses in control groups for PCB studies conducted in the same time frame as that of Allen et al. (1979). Even though this level of reproductive performance is highly unusual, it can only be assumed from the information given that no fetal losses were experienced in the control group. Otherwise, a LOAEL to NOAEL uncertainty factor of 3 could be justified. The somewhat lower birth weights and weight gain observed in the study relative to controls was not characterized by the authors as statistically significant. Schantz et al. (1989) made similar observations in PCB 1248 rhesus monkey studies conducted at the same laboratory at maternal exposure levels of 0.016 and 0.040 mg/kg-day. They also characterized the hyperpigmentation of infants as mild, and reversible after weaning at these exposure levels. This implies that the 0.008 mg/kg-day exposure level in the Allen et al. (1979) study is close to a NOAEL dose. This justification is similar to that used by the USEPA for using the uncertainty factor of 3 for NOAEL estimation in deriving the RfD for PCB 1254 because of the less severe effects on periocular tissues and nail beds in rhesus monkeys at lower doses (IRIS, 1995; see Appendix 6-F).

- Extrapolation from rhesus monkeys to man = 1
  - Explanation: The vast majority of differences in the severity of toxic effects at similar dose levels of a given chemical among test animal species is related to differences in metabolism and toxicokinetics. Comparative PCB metabolism and toxicokinetic studies in man relative to monkeys, dogs, and rats show that these species handle PCBs in a manner similar to people (Schnellman et al., 1983, 1984, 1985). Monkeys match best with the human data, a conclusion which is corroborated by the Agency for Toxic Substances Disease Registry (ATSDR, 1991) and the USEPA (IRIS, 1995; see Appendix 6-F). This close similarity between monkeys and humans based on data that are rarely available in people, and the fact that rhesus monkeys exhibit adverse PCB health effects at doses ten-fold lower than in other species, justifies direct extrapolation to people.

- Human variability = 10
  - Explanation: Standard default.

6.4.3.2.1.2 Immunologic Effects and Potential Additive Toxicity

The potential for additive toxicity of PCB 1248 and PCB 1254 was evaluated. According to USEPA guidance, additivity is to be considered if two or more compounds affect the same target organ or have the same mechanism of action (USEPA, 1989a). Developmental toxicity, the critical effect of PCB 1248, is not listed in IRIS or any other database searched as a critical effect of PCB 1254. Immunological effects are a critical effect listed in IRIS for PCB 1254. PCB 1248 also elicits immunologic effects. Therefore, potential additive effects of PCB 1248 and PCB 1254 were evaluated with respect to immunologic effects. The application of additive toxicity is discussed in the risk characterization (Section 6.4.4).

The lowest dose at which an immunologic effect was observed for PCB 1248 is 0.2 mg/kg-day (Thomas and Hinsdill, 1978). After eleven months on experimental diets resulting in a dose level of either 0.1 or 0.2 mg/kg-day, two groups of eight rhesus monkeys were injected intravenously with sheep erythrocytes (SRBCs). A third, control group was likewise injected with SRBCs. Compared to the 0.1 mg/kg-day and control groups, the 0.2 mg/kg-day group showed a significantly reduced SRBC antibody titer one week after primary immunization. At a dose of 0.1 mg/kg-day, no immunologic effect was observed. This lower dose is regarded as a NOAEL for immunologic effects. An uncertainty factor of 10 to extrapolate chronic exposure, a factor of 10 to account for human variability, and a factor of 1 to extrapolate from rhesus

monkeys to humans (Section 6.4.3.2.1.1) were used to estimate a PCB 1248 provisional RfD for immunologic effects. If the NOAEL for immunologic effects (0.1 mg/kg-day) is divided by the combined factor of 100, the resulting provisional RfD is 1×10^{-3} mg/kg-day. This value is about 12 times greater than the provisional RfD calculated for developmental effects.

As shown in Table 6-7, the established RfD for PCB 1254 is 2×10^{-5} mg/kg-day. This value is based on ocular exudate, meibomian gland effects, distorted growth of nails, and decreased antibody response to SRBCs in rhesus monkeys dosed at 5×10^{-3} mg/kg-day (IRIS, 1995). The provisional RfD of PCB 1248 with regard to immunologic effects is 50 times higher than the RfD for PCB 1254.

Even though the critical effects of PCB 1248 and PCB 1254 are different, potential additive immunologic effects may affect the estimation of MPS values. As stated above, the RfD for PCB 1254 is 50 times lower than the provisional RfD for PCB 1248 based on immunologic effects. Therefore, 50 mg/kg of PCB 1248 equals 1 mg/kg of "PCB 1254 equivalents" in the use of this relationship to estimate acceptable residual PCB soil concentrations.

Additivity with regard to developmental effects might also be pertinent if PCB 1248 was detected at significantly higher concentrations than PCB 1254 at the Site. However, in the databases that exist for site soil, PCB 1254 is detected with greater frequency and generally at higher concentrations than PCB 1248. Thus, the critical immunologic effects of PCB 1254 and the additive immunologic effects of PCB 1248, from a toxicity viewpoint, "drive" the estimation of MPS values for PCBs.

6.4.3.3 Health Criteria for Cancer Effects

Human carcinogens and potential human carcinogens are categorized into the following groups by USEPA Human Health Assessment Group's weight-of-evidence classification system:

- **Group A**
  Human Carcinogen (sufficient evidence of carcinogenicity in humans).
- **Group B**
  Probable Human Carcinogen (B1--limited evidence of carcinogenicity in humans; B2--

sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans).

- **Group C**
  Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data).
- **Group D**
  Not Classifiable as to Human Carcinogenicity (inadequate or no evidence).
- **Group E**
  Evidence of Noncarcinogenicity for Humans (no evidence of carcinogenicity in adequate studies).

Quantitative cancer risk assessments are performed on chemicals in Groups A and B, and on a case-by-case basis for Group C. The quantification of potential human cancer risks exhibited by a chemical is based on its cancer slope factor (CSF). In practical terms, a CSF is an estimate of the risk associated with a chronic daily intake of one milligram of chemical per kilogram of body weight $(mg/kg\text{-}day)^{-1}$. Separate CSFs are derived for the oral (CSF_o) and inhalation (CSF_i) exposure routes. Typically, IRIS lists no CSF_i value, but instead lists an inhalation unit risk (UR_i). The UR_i is the potential cancer risk associated with an average lifetime exposure to an airborne concentration of one microgram of a chemical per cubic meter of air $(\mu g/m^3)^{-1}$. UR_i values can be converted to provisional CSF_i values using exposure assessment methodologies. Similar to the case of noncancer effects (Section 6.4.3.2), CSF_o values may be used for the dermal absorption exposure route, using chemical-specific factors to adjust for the differences in absorption between the oral and dermal routes.

CSFs are calculated through the use of mathematical extrapolation models. Generally, the USEPA currently limits its extrapolation to the linearized, multistage model, despite heavy criticism from the scientific community. This model incorporates data from studies performed using high doses relative to potential environmental exposure, and estimates the largest possible linear slope within the 95th percentile upper confidence limit, extrapolating the study data to a low dose. Because of the choice of mathematical model and of the 95th percentile upper confidence limit, the CSF represents a conservative, upper-bound estimate of the potential cancer risk of a chemical to humans.

6.4.4 Risk Characterization

The objective of risk characterization is to evaluate and quantify the potential risks associated with a site. This is done by combining the exposure levels estimated in the exposure assessment (Section 6.4.2) with the appropriate toxicity criteria identified during the toxicity assessment (Section 6.4.3) to quantitatively estimate potential cancer risk for carcinogens and the potential for noncancer adverse health effects. Because of basic differences in the mechanisms of toxicity, the risks associated with cancer and noncancer adverse health effects of chemicals are characterized separately. Risk characterization methodologies used in the PHRA are consistent with the HHEM and are described in Appendix 6-G. The following provides an overview of the process used in risk characterization.

The total hazard index (THI) represents the overall calculated noncancer risks posed by the COPCs in a given exposure scenario. The calculation of the THI and associated values such as hazard quotients (HQs) and hazard indices (HIs) are described in detail in Appendix 6-G. Briefly the THI is the sum of the separate chemical-specific HQ values for all of the COPCs, via all the relevant routes of exposure for the exposure scenario. The HQ is calculated by dividing the estimated chemical intake level (IN) to a chemical, via one exposure pathway, by the appropriate RfD. Both the IN and the RfD are given in units of milligrams of chemical per kilogram of body weight per day (mg/kg-day). Thus, if the IN is greater than the RfD, the HQ will exceed a threshold value of 1. The chemical-specific HI is the sum of all HQ values (via all exposure pathways) for a particular COPC.

To evaluate noncancer risk, the THI is compared to a target value of 1. The THI is rounded to one significant figure in accordance with the HHEM. If the THI is less than or equal to 1, then it is unlikely, given the exposure assumptions, that the COPCs present a health risk. If the THI (rounded to one significant figure) exceeds 1, then separate THI values should be calculated for the separate target organs. If any of the resultant target organ-specific THI values exceed the target value of 1, then a potential for adverse health effects may be indicated. When exposure to multiple chemicals with the same target organ exist, the combined effect of the chemicals may be additive, synergistic, antagonistic, or they may have no influence on one another at all. Antagonistic relationships result in health effects that are less than those predicted by a chemical given alone; synergistic relationships result in health effects that exceed the results predicted by a chemical given alone and the additive effects of chemicals with similar effects. Combined noncancer health effects on the same target organ are assumed to be additive in the PHRA. It should be noted that the THI value is to be compared to the threshold value of 1, and should not

be used as an independent, quantitative estimator of risk. The reasons for this are related to the assumption discussed in Section 6.4.3.1 of the toxicity assessment that a threshold level of exposure must be exceeded before chemicals elicit adverse noncancer health effects.

The total incremental lifetime cancer risk (ILCR) is the sum of all estimated potential cancer risks associated with all carcinogenic chemicals in a given exposure scenario. Combined cancer risks associated with exposure to multiple carcinogens are assumed to be additive, unless available information suggests otherwise. In weighing exposures to potentially carcinogenic compounds, a reasonable level of risk must be selected. Cancer is of significant occurrence in the United States with an estimated lifetime risk of developing cancer being about three out of every ten people (3×10^{-1}) (American Cancer Society, 1990). Approximately 80 percent of these cases result in death directly attributable to the disease. The USEPA regards an ILCR of between 1×10^{-6} (1 in 1,000,000) and 1×10^{-4} (1 in 10,000) as acceptable. Thus, this may be interpreted as an increase in the United States baseline cancer incidence from 300,000 per million population to a range of 300,001 to 300,100 per million population. Under the Resource Conservation and Recovery Act (RCRA), this is regarded as the protective risk range for media protection standards (USEPA, 1990b). Alternatively, a project-specific target risk range or risk level may be used. If the ILCR exceeds the upper bound of the target risk range, then further evaluation or corrective action may be indicated.

6.4.4.1 Special Considerations of PCBs

6.4.4.1.1 PCB 1248 and PCB 1254

Section 6.4.3.2 discusses the differences in the respective critical effects for PCB 1248 and PCB 1254. PCB 1254 has an RfD of 2×10^{-5} mg/kg-day based on immunologic effects. A provisional RfD of 8×10^{-5} mg/kg-day was derived for PCB 1248, based on developmental effects. This developmental effects RfD was used in the risk characterization. Because the RfD for PCB 1254 and the provisional RfD for the critical effect of PCB 1248 are based on different target organs and mechanisms of toxicity, hazard indices that result from these RfDs are not additive.

A provisional RfD was also derived for PCB 1248 that is specific for immunologic effects; this value is 1×10^{-3} mg/kg-day. This immunologic-based RfD for PCB 1248 was also used in the

risk characterization. The resultant HI is summed with the HI for PCB 1254 to estimate an additive effects THI for immunologic effects, referred to as the "Combined PCB THI".

6.4.4.1.2 Total PCBs

The analytical results of all detected PCBs were summed and referred to as total PCBs. These are PCB 1248, PCB 1254, and PCB 1260 in the Production Area; PCB 1248 and PCB 1254 in the Warwick Area; and PCB 1254 in the Waste Water Treatment Area. The resultant data set was treated as if total PCBs were a different chemical. Total PCBs was used in the risk characterization, using the Region I policy assumption that the combination of all PCBs is equal in cancer potency to PCB 1260 (USEPA 1995b). This practice is not consistent with PCBs toxicity data. A large toxicity database exists for PCB 1254, from which it is concluded that it is not carcinogenic. Also, existing studies suggest that PCB 1248 is not carcinogenic. Since most of the PCBs detected at the Site are PCB 1254 and PCB 1248, to assume that these mixtures are carcinogens with the same cancer potency as PCB 1260 grossly overestimates potential cancer risks.

6.4.4.2 Risk Characterization Results

6.4.4.2.1 Production Area

Production Area noncancer and cancer effects risk characterization results are summarized in Tables 6-8, 6-9, and 6-10 for the workers and the canoeist.

6.4.4.2.1.1 On-Site Worker

The THI for the Production Area on-site worker is estimated as 0.9 (Table 6-8). This value assumes that the noncancer effects of all COPCs are additive. The Combined PCBs THI for the Production Area on-site worker is estimated as 0.4. These values do not exceed the target value of 1. Thus, adverse noncancer health effects associated with Site soils are unlikely to occur in the Production Area. Regarding potential cancer risks, the total ILCR is estimated as 1×10^{-4}, with Total PCBs accounting for virtually 100% of the estimated potential total ILCR. This is within the RCRA protective risk range of 10^{-6} to 10^{-4}.

Overall, both cancer and noncancer potential human health risk estimates are below their respective "action" criteria for the on-site worker in the Production Area. Of the three PCBs detected on Site, toxicological data indicate that PCB 1248 and PCB 1254 are noncarcinogenic; only PCB 1260 appears to be carcinogenic in animals (see Section 6.4.4.1.2). Region I policy is

to assume that all PCBs have a cancer potency equal to that of PCB 1260. PCB 1260 comprises only about 4% of the total PCBs detected in the Production Area. If PCB 1248 and PCB 1254 are considered as noncarcinogens, the estimated potential ILCR for the on-site worker is 6×10^{-6}. This value is also within the RCRA protective cancer risk range.

6.4.4.2.1.2 General Worker

The THI for the general worker is estimated as 0.8 (Table 6-9). This value assumes that the noncancer effects of all COPCs are additive. The Combined PCBs THI for this worker is estimated as 0.3. These values do not exceed the target value of 1, indicating that adverse, noncancer health effects associated with the Production Area soils are unlikely to occur. Regarding potential cancer risks, the total ILCR is estimated as 1×10^{-4}, with total PCBs accounting for virtually 100% of this value. This value is within the RCRA protective risk range of 10^{-6} to 10^{-4}.

Overall, both cancer and noncancer potential human health risk estimates are below their respective "action" criteria for the general worker in the Production Area. Of the three PCBs detected in the Production Area, PCB 1260 is the only one that toxicological data indicate is carcinogenic (see Section 6.4.4.1.2). Region I policy is to assume that all PCBs have a cancer potency equal to that of PCB 1260. PCB 1260 comprises about 4% of the PCBs detected in the Production Area. If PCB 1248 and PCB 1254 are regarded as noncarcinogenic, the estimated potential ILCR for the nonspecific commercial/industrial worker in the Production Area is 5×10^{-6}. This value is also within the RCRA protective risk range.

6.4.4.2.1.3 Canoeist

The THI for the Production Area canoeist is estimated as 0.0006, with over 85 percent of this value being associated with 2-nitroaniline (Table 6-10). This value is far less than the target THI criterion of 1. Thus, noncancer human health effects associated with potential impact of COPCs in the Production Area to the Pawtuxet River are effectively nonexistent.

The ILCR is estimated as 2×10^{-7}. This value is less than the RCRA protective risk range of 10^{-6} to 10^{-4}. Moreover, the ILCR value in the canoeist scenario for total PCBs was calculated by summing the individual contributions of the three PCBs and, then, assuming that PCB 1248 and PCB 1254 are carcinogenic and have the same cancer potency as PCB 1260. Toxicological evidence indicates that neither PCB 1248 nor PCB 1254 are carcinogenic. If these two

compounds are excluded from the evaluation of carcinogens, the estimated ILCR is much lower (7×10^{-10}).

6.4.4.2.2 Waste Water Treatment Area

Waste Water Treatment Area noncancer and cancer effects risk characterization results are summarized in Tables 6-11 and 6-12 for the on-site resident and canoeist, respectively.

6.4.4.2.2.1 On-Site Resident

The THI for the hypothetical future on-site resident is estimated as 0.4. This value is less than the target THI criterion of 1. Thus, noncancer health effects associated with Site media are unlikely to occur. Regarding potential cancer risks, the total ILCR is estimated as 3×10^{-5}. This value is within the RCRA protective cancer risk range of 10^{-6} to 10^{-4}. Overall, both cancer and noncancer potential human health risk estimates are below their respective "action" criteria for the Waste Water Treatment Area on-site resident.

6.4.4.2.2.2 Canoeist

The THI for the Waste Water Treatment Area canoeist is estimated as 0.000005. This value is far less than the target THI criterion of 1. Thus, noncancer human health effects associated with potential impact of COPCs in the Production Area on the Pawtuxet River are effectively nonexistent.

The ILCR is estimated as 9×10^{-10}. This value is far less than the RCRA protective risk range of 10^{-6} to 10^{-4}. Moreover, the ILCR value in the canoeist scenario for total PCBs was calculated by assuming that PCB 1254 is carcinogenic and has the same cancer potency as PCB 1260. Toxicological evidence indicates that PCB 1254 is not carcinogenic.

6.4.4.2.3 Warwick Area

The Warwick Area noncancer and cancer effects risk characterization results are summarized in Tables 6-13 and 6-14 for the on-site resident and the canoeist, respectively.

6.4.4.2.3.1 On-Site Resident

The THI for the hypothetical Warwick Area on-site resident is estimated as 2 (Table 6-13). This is derived by combining the HI values of all COPCs, and assuming that these effects are additive. This value exceeds the target THI criterion value of 1. Exceeding the criterion value, as mentioned in Section 6.4.3.2, does not necessarily indicate a potential human health risk.

The HHEM recommends that when a THI exceeds 1, the next step in the risk assessment process is to evaluate the potential human health effects by separate target organs. The COPCs contributing to 95% of the noncancer risk are PCB 1254 (HI=0.91), PCB 1248 (HI=0.66), and 2-Nitronaniline (HI=0.63). The target organ is different for each of these compounds, thus the HIs should not be regarded as additive.

PCB 1254 was found to have the highest HI. Its critical effects include a decreased antibody response. Even though toxicity studies report the critical effect of PCB 1248 to be developmental effects, PCB 1248 has also been observed to have immune system effects at higher doses (see Section 6.4.3.2.1). A provisional RfD of 1×10^{-3} mg/kg-day was derived for the immunological effects of PCB 1248, approximately 1/12 that used for the developmental effects of PCB 1248. An HI of approximately 0.06 is estimated for the developmental effects of PCB 1248 by multiplying the HI for the developmental effects of PCB 1248 (0.66) by 1/12. The immunological effect of PCB 1248 can conservatively be considered additive with the critical effect of PCB 1254. This results in a target organ-specific THI of 1 for immunological effects, which equals the target criterion. None of the other target organ-specific THI values would be greater than that for developmental effects (0.7) as none of the other COPCs are additive with either the effects of PCB 1248 or 2-nitroaniline. This indicates that adverse noncancer health effects are unlikely to occur in the Warwick Area.

The total ILCR for the hypothetical future on-site resident is estimated as 3×10^{-4}. This value is the RCRA protective risk range of 10^{-6} to 10^{-4}. However, the USEPA Region I policy is to assume that all PCBs have a cancer potency equal to that of PCB 1260 (USEPA, 1995b). Total PCBs for the Warwick Area is comprised of only PCB 1248 and PCB 1254. As stated in Section 6.4.4.1.2, this practice is not consistent with PCB toxicity data. This is particularly true for the Warwick Area where no PCB 1260 was detected. To assume that these compounds have the same cancer potency as PCB 1260, when they are regarded as noncarcinogenic, greatly exaggerates potential cancer risks. The ILCR of the COPCs excluding total PCBs is 6×10^{-5}. This value also is within the RCRA protective risk range (10^{-6} to 10^{-4}).

Overall, the noncancer health effects have HI values less than the target criterion of 1, a THI of 2, and a maximum target organ-specific THI of 1. These values indicate that the action criterion for the hypothetical on-site resident is met. If noncarcinogenic PCB 1248 and PCB 1254 are assumed to have the same cancer potency as PCB 1260, the result is an ILCR of 3×10^{-4}.

However, if only carcinogens (Classes A, B, and C) are considered, the resultant ILCR is 6×10^{-5}. This value meets the "action" criteria for the hypothetical on-site resident.

6.4.4.2.3.2 Canoeist

The THI for the Warwick Area canoeist is estimated as 0.002, with over 95 percent of this score being associated with 2-nitroaniline. This value is far less than the target THI criterion of 1. Thus, noncancer human health effects associated with potential impact of COPCs in the Warwick to the Pawtuxet River are effectively nonexistent.

The ILCR is estimated as 2×10^{-8}. This value is far less than the RCRA protective risk range of 10^{-6} to 10^{-4}. Approximately 60 percent of the ILCR is associated with beryllium, a naturally occurring component of soils, and about 35 percent of this ILCR is associated with total PCBs. Further, the ILCR value in the canoeist scenario for total PCBs was calculated by summing the individual contributions of PCB 1248 and PCB 1254 and, then, assuming that these two compounds are carcinogenic and have the same cancer potency as PCB 1260. Toxicological evidence indicates that neither PCB 1248 nor PCB 1254 are carcinogenic. If the two PCB compounds are excluded from the evaluation of carcinogens, the estimated ILCR is even lower (1×10^{-8}).

6.4.4.2.4 Background

Cancer and noncancer risks of chemicals determined to present at site-specific background concentrations were also characterized for the Production Area worker scenarios and the Waste Water Treatment and Warwick Area on-site resident scenarios. The major "risk drivers" with respect to background compounds were previously determined for each Site area (see Section 6.3.2). The results of the background risk characterization are presented for the three site areas in the following subsections and are summarized in Tables 6-15 through 6-17.

6.4.4.2.4.1 Production Area

Cancer and noncancer risk results for the site-specific, on-site worker scenario and the nonspecific commercial/industrial on-site worker are summarized in Table 6-15. The background THI for the site-specific, on-site worker scenario was estimated as 0.009. Approximately 87% of this value is associated with arsenic. The background ILCR was estimated as 4×10^{-6}, with about 47% of this associated with benzo(a)pyrene and 34% with arsenic.

The background THI for the nonspecific, commercial/industrial worker was estimated as 0.004, with approximately 83% of this value being associated with arsenic. The background ILCR under this scenario was estimated as 3×10^{-6}, with benzo(a)pyrene accounting for approximately 58% of this value.

6.4.4.2.4.2 Waste Water Treatment Area

The background THI for the Waste Water Treatment Area on-site resident was estimated as 0.09, with about 52% of this value associated with arsenic and 34% with manganese. The background ILCR for under this scenario was estimated as 1×10^{-4}, with dibenz(a,h)anthracene, beryllium, and benzo(a)pyrene contributing approximately 41%, 28%, and 21% of this value, respectively.

6.4.4.2.4.3 Warwick Area

The background THI for the Warwick Area on-site resident was estimated as 0.1, with arsenic accounting for about 58% of this value. The background ILCR was under this scenario was estimated as 4×10^{-5}, benzo(a)pyrene contributing about 64% of this value and arsenic the remaining 36%.

6.4.5 Uncertainties

One of the primary objectives of the PHERE is to characterize and quantify potential risks. The very nature of risk, being comprised of probability statements, connotes that uncertainty is involved. The fact that potential risks in the PHERE are called "potential" accentuates the associated uncertainty because the risks evaluated do not exist at this time. In addition, there are uncertainties associated with the COPC selection process, future land-use scenarios, transport models, exposure input values, toxicity values, and the risk characterization process.

6.4.5.1 COPC Selection Process

The COPCs were selected using a screening process described by the USEPA in the HHEM. While the method is useful for screening, it is based on oral toxicity values and does not address chemical-specific differences to such variables as environmental contaminant transport, dermal absorption rates, and toxicities via exposure routes other than ingestion.

6.4.5.2 Future Land-Use Scenarios

Future land use for the Production Area will be a City of Cranston parking lot and storage facility for road salt, sand, and snow removal equipment. It will include covering the Production Area with approximately one foot of soil and six inches of asphalt. This is based on the plans of the

City of Cranston (1995) and Ciba. This future land use has a high level of certainty. However, because the assumption was made in calculating potential risks that the Production Area would not be paved or in any way covered, the PHERE greatly exaggerates exposure to contaminated soil, and thus, greatly overestimates potential cancer and noncancer risks. A soil and asphalt cover will dramatically reduce soil-to-air and soil-to-groundwater transport, and worker ingestion and dermal contact with the impacted soil will essentially be eliminated. Because of the planned use of the site already described, the general worker is regarded as an unlikely receptor.

Unrestricted residential land use is conservatively assumed for the Waste Water Treatment and Warwick Areas because there is uncertainty as to the future use. Although residential land use is not necessarily the most relevant for these Site areas, it represents a "worst-case" future land use scenario. Future industrial or commercial use of these areas is regarded as very plausible. The assumption of residential land use overestimates the exposure associated with an industrial or commercial land-use scenario.

6.4.5.3 Transport Models

Soil-to-air and soil/groundwater-to-Pawtuxet River transport models were used in the PHRA to estimate COPC exposure point concentrations of air and river water, respectively, attributable to each of the three Site areas (Appendices 6-D and 6-E).

The soil-to-air models were intentionally selected and used in a manner that would tend to overestimate potential exposures of people. For example, a simple event of neutral stability, a mean annual wind speed, and a constant worst-case wind direction were assumed conditions. Also, it was assumed that the soil surface contained no hardened crust. These are unrealistic assumptions which, together, exaggerate wind dispersion of soils and result in overestimates of exposure.

Similarly, the soil/groundwater-to-Pawtuxet River water model is based on conservative assumptions. As an example of a conservative assumption, the model accepts either the greater of the measured groundwater concentrations, or the groundwater concentration based on measured soil concentrations, to estimate Pawtuxet River concentrations. This results in calculating risks on the river water concentrations of several compounds that have not been detected in any groundwater samples collected on-site.

If the Production Area were to be covered with soil and paved, as is planned, exposure to the on-

site worker would be dramatically reduced. The ingestion and dermal absorption pathways would be effectively eliminated, as would airborne particulate emissions. Only the inhalation of volatile emissions would remain as an exposure pathway, and it is estimated that the soil/asphalt cap would reduce volatile emissions by more than 95 percent. This would result in an ILCR and HI to the on-site Production Area worker of approximately 7×10^{-10} and 0.0001, respectively. Likewise, it is expected that the asphalt/soil cap will greatly reduce infiltration of rainwater through the zone of impacted soil. This would decrease mobility of the COPCs in the soil, and prevent leaching to groundwater. As a result, the concentration of COPCs in the Pawtuxet River would be reduced; consequently, exposure to the hypothetical canoeist would also be reduced.

6.4.5.4 Exposure Assumption Values

Exposure assumption values used in the exposure assessment are generally regarded as overestimates of the "true" values. The HHEM advocates a "reasonable maximum exposure" (RME) approach to exposure assessment. The RME does not assume "worst-case" values for each exposure assumption value. However, the RME values recommended by the HHEM, such as contact rates, exposure frequencies, and exposure duration, are decidedly conservative (e.g., 95th percentile UCLs of possible values). The PHRA basically followed the HHEM approach, using assumption values that were reviewed by Region I in the May, 1994, meeting and discussed during subsequent meetings and teleconferences. A few are somewhat less conservative than the default RME values which appear in the HHEM. Although there is uncertainty associated with every selected value, a few of these exposure variables are highlighted in the following paragraphs.

Maximum detected and 95th percentile UCL of the mean concentrations were used as the chemical concentration values. These are overestimates of average values. It is noted that concentrations that were qualified as estimated values during data validation ("J values") were also used in the PHRA to derive the concentration values; nondetected values were assumed to be one-half the sample quantitation limits (SQL). These practices are consistent with the HHEM. The use of "J values" may result in either an overestimate or underestimate of actual average concentrations. Because many of the "J values" are less than one-half their respective SQLs, the assumption that a concentration equal to one-half the SQL is present, tends to overestimate actual average concentrations.

The soil ingestion rates (IR_s) are considered overestimates of actual values. The IR_s used in the exposure assessment for the on-site resident scenario is 200 mg/day for young children and 100

mg/day for older children and adults, as suggested in the HHEM. An ingestion rate of 50 mg/(work)day of soil was assumed for the on-site worker scenario. However, in studies by Calabrese, et al., (1989) using 64 subjects, the median of the range for daily soil ingestion by young children (ages 1 through 4 years old) was found to be 9 to 40 mg per day, depending on the tracer element used for the study. Work cited in the Exposure Factors Handbook (USEPA, 1990a) suggests that individuals 5 years of age and older ingest on average approximately 10 mg of soil per day. Soil ingestion for the resident scenario and contact were assumed to be proportionate to the amount of time spent at the Site. This is an overestimate, especially for adults, since one of the primary sources of ingested soil is associated with food. In addition, if the Production Area were to be paved, the soil ingestion value would be virtually eliminated, making the ingestion of Production Area surface soil an incomplete exposure pathway.

The exposure duration used for the on-site resident scenario and on-site worker are 30 and 25 years, respectively. Few individuals work at the same location with the same job for as long as 25 years. The on-site resident scenario exposure duration is far greater than the median duration time of 9 years that an individual typically lives at a residence as referenced in the HHEM. These conservative exposure values, when combined, may overestimate the potential risk by two orders of magnitude over more realistic exposure assumptions, depending on the exposure scenario and the exposure values selected. This does not include the overestimations of toxicity discussed in Section 6.4.5.5.

6.4.5.5 *Toxicity Assessment*

Uncertainties pertaining to the toxicity assessment are discussed in Section 6.4.3. These include uncertainties regarding development of the health effects criteria values, the classification of carcinogenicity, the extrapolation of exposure route-specific toxicity values to other routes of exposure, and the extrapolation of toxic effects observed in animal studies to potential adverse health effects in people. A summary of these uncertainties is provided in the following paragraphs.

The development of health effects criteria for noncancer health effects involves professional judgement. Depending on the nature of the toxicity studies, a safety factor of up to nearly four orders of magnitude may be built into the RfD or RfC value.

The USEPA weight-of-evidence classification system for carcinogens is used to examine and classify chemical agents with respect to their human carcinogenic potential. Most compounds

that the USEPA classifies as carcinogens, including the COPCs examined in the PHRA, are B2 carcinogens. The carcinogenicity of these chemicals is based on animal data. There is uncertainty as to the nature of the carcinogenic response in humans, if any. Also, the mathematical models used to extrapolate from relatively high-dose rodent studies to relatively low-dose human exposures are the subject of much controversy. The approach taken by USEPA of almost exclusively using the linearized multistage model, combined with other assumptions, tends to overestimate potential ILCR. The USEPA is currently revising its carcinogen policies. The revised policies may be enacted during 1995 or 1996. These could potentially impact the PHERE.

When a noncancer or cancer health effects criterion was not available for a given route of exposure, the criterion from another route of exposure was adopted for use. This practice adds uncertainty and may either overestimate or underestimate toxicity.

A provisional RfD was derived for PCB 1248 because the USEPA has not established an RfD. An uncertainty factor of 10 was used in the estimation of a NOAEL for a LOAEL observed in a study on rhesus monkeys. An uncertainty factor of 3 may be justifiable, except the investigators of this critical study omitted key information about reproductive performance in the control group and their rhesus colony in general (see Section 6.4.3.2.1).

Total PCBs was used in the risk characterization, using the Region I policy assumption that the combination of all PCBs is equal in cancer potency to PCB 1260 (USEPA 1995b). This practice is not consistent with PCBs toxicity data. A large toxicity database exists for PCB 1254, from which it is concluded that it is not carcinogenic. Also, existing studies suggest that PCB 1248 is not carcinogenic. Since most of the PCBs at the Site are PCB 1254 and PCB 1248, to assume that these mixtures are carcinogens with the same cancer potency as PCB 1260 grossly overestimates potential cancer risks.

6.4.5.6 Risk Characterization

Uncertainty inherent to the risk characterization process involves the additivity assumption of adverse health effects associated with different chemicals. Chemicals in combination may act additively, antagonistically, synergistically, or not influence each other at all. Antagonistic relationships result in health effects that are less than those predicted by a chemical given alone; synergistic relationships result in health effects that exceed the results predicted by a chemical given alone, and additivity is the predicted sum of responses for chemicals with similar effects.

Therefore, the assumption of additivity used in the PHRA may either overestimate or underestimate human health risks.

The conservativeness of health effects criteria are discussed in Section 6.4.4.1. This conservativeness is compounded in the risk characterization process where multiple conservative values are combined together. This tends to exaggerate potential risks. Also, as discussed in Section 6.4.5.5, the Region I assumption that total PCBs are carcinogenic and have the same cancer potency as PCB 1260 grossly overestimates potential cancer risks.

6.5 Terrestrial Ecological Risk Assessment

This baseline ecological risk assessment utilizes the procedures found in the *Framework for Ecological Risk Assessment* (USEPA, 1992b) and *Ecological Assessment of Superfund sites: An Overview* (USEPA 1991d). Detailed descriptions of the Site and Site history are found in Section 1.0 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI). The Site is divided into three areas: Production, Waste Water Treatment, and Warwick (Figure 6-7). Analysis is presented for each of these areas.

6.5.1 Objectives and Scope

The main objective of this baseline ecological risk assessment is to evaluate the potential risks posed to ecological receptors by COPCs contained in surface soils (0-2 feet) at the Production, Waste Water Treatment, and Warwick Areas and the small groundwater seep in the Waste Water Treatment Area of the Site. Specific objectives are to:

- review ecological data,
- summarize the data into a description of ecological conditions at the Site,
- review data on the chemical contamination of the surface soils and select COPCs based on physiochemical and ecologically relevant criteria,
- develop a conceptual model to identify reasonable exposure pathways and potential ecological receptors, and
- make an assessment of the potential for COPCs to induce adverse ecological effects.

6.5.2 Environmental Setting

A complete site description is found in Sections 1, 2, and 3 of the RFI. The description in this report is focused on the ecological risk assessment.

6.5.2.1 Physiography

The total area of the Site is approximately 25 acres: 8 acres north of the Pawtuxet River in Cranston and 17 acres south of the river in Warwick (Ciba, 1990). The Site is bordered to the north and south by residential areas, to the east by commercial areas, and to the west by a mixed industrial area also owned by Ciba.

The topography of the Site is relatively flat with gentle slopes toward the Pawtuxet River with elevations ranging from about 10 to 25 feet above mean sea level. The Pawtuxet River, a major waterway, flows from west to east through the Site and is about 80 feet wide as it passes the Site.

The entire Warwick Area and about half of the Waste Water Treatment Area are within the 100-year flood plain with about 10 percent of the Production Area along the river being within the 100-year flood plain (FEMA, 1982, 1984).

Two small wetlands and the Pawtuxet River riparian zone are on-site. The Pawtuxet River is designated by the U. S. Fish and Wildlife Service National Wetland Inventory system as R2OW, indicating a free flowing river (open water, lower perennial riverine system). Natural groundwater discharge in the Waste Water Treatment Area appears responsible for a seep wetland (seep) of about 0.25 acre. In the Warwick Area there is a small depressional area of about 0.05 acre located in the northwest corner near the river (Gautreau and Hastings, 1995).

6.5.2.2 *Ecological Features*

Terrestrial habitats within the Site include upland and riparian wooded and open areas. The upland open areas support plants typical of open fields, roadsides, and areas including both native and exotic plants such as goldenrod, thistle, Queen Anne's lace, milkweed, common mullein, plantain, tickseed, and evening primrose. The edges of wooded upland areas support plants such as staghorn sumac, the exotic Tree-of-Heaven, and multiflora rose which is also found in the wooded areas. Shrubs found in upland wooded areas noted in the Waste Water Treatment Area include lowbush blueberry and rosebay. English ivy and poison ivy serve as both ground plants or cover and vines. Trees include black oak, which prefers drier sites, and black cherry, northern red oak, white oak, Norway maple (introduced), and three species of pine-Austrian (introduced), shortleaf, and white pine-which can tolerate more moisture variations. Trees found in the upland areas but more typical of riparian areas include cottonwood and gray birch with the shrub northern bayberry and herb Japanese knotweed. Table 6-H-1 (Appendix 6-H) provides a complete listing of terrestrial plants and animals noted during the March, 1992 field survey.

The herbaceous layer found in the riparian/wetland areas of the Site include sensitive fern, reed canary grass, soft rush, tussock sedge, cattail, and greenbrier. The riparian shrub/small tree layer includes pepperbush, pussy willow, highbush blueberry, red-osier dogwood, and speckled alder. Riparian area trees include black willow, bear oak, northern red oak, swamp white oak, white oak, black gum, gray birch, mockernut hickory, box elder, red maple, silver maple, American elm, sassafras, and eastern hemlock.

Birds found on site include species which prefer open areas and forest edges such as killdeer,

mourning dove, domestic pigeon, European starling, mockingbird, house sparrow, and American robin. Woodland and edge area birds include Coopers' hawk, red-tailed hawk, great horned owl, blue jay, common crow, black-capped chickadee, cardinal, dark-eyed junco, and song sparrow. Birds found on site preferring a riparian habitat include great blue heron, Canada goose, black duck, American widgeon, mallard, wood duck, hooded merganser, red-winged blackbird, and belted kingfisher.

Mammals on site utilizing both upland and riparian wooded and open areas include the eastern cottontail rabbit, eastern gray squirrel, muskrat, and raccoon with the latter two especially utilizing the riparian area.

6.5.2.3 Protected Species and Habitats

The Ciba Site, located in an industrial park within the urbanized areas of the cities of Cranston and Warwick, has little natural area and is unlikely to provide suitable habitat for endangered plant or animal species. There are no federally designated critical habitats in Rhode Island (Reithel, 1994).

6.5.3 Problem Formulation

This section provides a description of potential ecological problems at each study site and defines objectives for the ecological assessment based on site information. Site history, chemical analyses for soils, potential migration and exposure pathways, potential ecological receptors (habitats and species), and ecologically appropriate assessment and measurement endpoints are discussed in this section.

6.5.3.1 Production Area

6.5.3.1.1 Site Description

This is a narrow, north-south trending rectangular area which parallels Mill Street on the west and broadens where it borders the Pawtuxet River to the southeast (Figure 6-7). Its total areal extent is approximately 2.8 acres (ac), all of which is cleared, open ground. This area fronts the Pawtuxet River for approximately 114 meters (m) (370 feet); however, no riparian vegetation remains along the shoreline. Pedestrian and combined railroad/vehicle bridges cross the river to connect this area with the Warwick Area (Figure 6-7).

6.5.3.1.2 Stressor Selection

Chemical contaminants are the primary stressors evaluated in this report. Chemicals of potential concern (COPCs) are chemicals that were detected in surface soils and which have the potential to adversely impact natural populations or ecosystems.

Analytical results from surface soil samples [0 to 2 feet (0 to 0.75 meters) depth] are used to determine concentrations of chemicals to be used in the risk assessment. Initial screening for identification of analytes as COPCs follows the path shown in Figure 6-8 and is based on the following criteria (USEPA, 1989b):

Blank Contamination: As part of the data validation process, a chemical was not considered further if the maximum sample concentration did not exceed 10 times the highest blank for all common laboratory contaminants (acetone, 2-butanone, methylene chloride, toluene, and phthalates) or five times the highest blank for other chemicals.

Frequency of Detection: Chemicals that are infrequently detected may be artifacts in the data due to sampling, analytical, or other problems. Chemicals were eliminated if they were detected in 5 percent or less of the samples.

Essential Nutrients: Calcium, iron, magnesium, manganese, potassium, sodium, and zinc are considered essential macronutrients and are generally toxic only at very high concentrations. These chemicals, except for zinc, were eliminated as COPCs, since they were not present at excessively high concentrations.

Water Chemistry: Indications of general water chemistry conditions (sulfates, carbonate, bicarbonate, chloride, and total dissolved solids) are also generally toxic only at very high levels. These chemicals were also eliminated as COPCs, since they were not present at excessively high concentrations.

Background: A *t*-test with separate variances was performed for polyaromatic hydrocarbons (a product of fossil fuel-burning) and metals found in background samples and initially selected according to human health risk criteria (See Section 6.3). If the site concentrations were not significantly higher ($\leq .05$) than background concentrations, they were eliminated as a COPC. If site concentrations were significantly higher than background concentrations, or no statistical tests were performed, they were considered a

COPC. If COPCs, that were not initially subjected to a *t*-test, resulted in a risk to animals on the Site, they were subjected to a *t*-test and included or eliminated as a COPCs according to the above criteria.

Regulatory Limits: Limits or regulatory criteria for surface soils for ecological risk assessment have not been promulgated at the state and/or federal level. Therefore, none are available for use.

Persistence: Persistence of chemicals was estimated from their degradation half-life ($t_{0.5}$) in soil and their estimated ability to bioaccumulate in terrestrial food webs. An analyte was identified as a COPC if its octanol-water partition coefficient [an estimator of bioaccumulation potential (Garten and Trabalka, 1983)] was >3.5 (Lyman, et al., 1982), or its half-life in soil was >14 days (336 hours).

Mobility: Mobility of chemicals is a function of water solubility and the soil sorption constant (K_{oc}). Highly water soluble compounds tend to leach from wastes or contaminated soils and are generally mobile in both groundwater or surface water. Soil sorption indicates the tendency for a constituent to be adsorbed to soil particles. Chemicals with $\log(K_{oc})$values <2 are weakly sorbed (and thus more mobile); $\log(K_{oc})$ values between 2 and 4 indicate moderate sorption; $\log(K_{oc})$ values >4 indicate strong adsorption to soils. An analyte was classified as potentially mobile and as a COPC if it exhibited a solubility >1 mg/L or a $\log(K_{oc}) < 3$ (BEIA, 1989).

Analytes selected as COPCs are shown in Table 6-18. Additional detail is found in Tables 6-H-2 and 6-H-3.

6.5.3.1.3 Exposure Pathway Identification

For exposures to occur, complete exposure pathways must exist, which require:

- a source and mechanism for COPC release,
- a transport medium,
- a point of environmental contact, and
- an exposure route at the exposure point (USEPA, 1989c).

If any of these four components is absent, a pathway is generally considered incomplete. However, the transport medium may be missing and the pathway may still be complete if the

contact point is directly at the contaminant release point. Specific potential exposure pathways include:

Dermal Contact (soil): Significant exposure via dermal contact would be limited to organic contaminants which are lipophilic and can cross epidermal barriers. Fur-bearing mammals and birds are less susceptible to exposure via dermal contact with soils because their fur or feathers prevents much of their skin surface from coming into full contact with soil. Calculations showed risk to deer mice and raccoons from dermal contact to be two to three orders of magnitude lower than risk from soil ingestion or ingestion of contaminated plants and animals. Young mammals or birds, which are normally born hairless or featherless, would be much more susceptible to transdermal exposure. Quantification of dermal exposure was therefore performed assuming young (newborn) rather than adult animals. Newborn shrews were used as representative newborn animals, since shrews are representative burrowing animals and have a large skin surface to body weight ratio. Calculations were performed to determine doses to newborn shrews from dermal contact (Table 6-H-4). These calculations were done using equations developed for dermal exposure (Hope, 1995) and all resulted in potential risks that were several orders of magnitude lower than risks from soil ingestion and from eating contaminated plants and animals. Thus, dermal contact was not considered to be a significant contributor to risk.

Root Contact (soil): Contaminants that can partition into soil interstitial waters may be taken-up via roots in contact with soil and translocated into edible foliage or reproductive structures (seeds). Terrestrial plants were assumed to be exposed primarily through contact with contaminated soils rather than with contaminated surface water.

Consumption (soil): Incidental soil ingestion may inadvertently occur while grooming, burrowing or consuming plants, insects or burrowing invertebrates resident in soil. Some organisms, such as deer, deliberately ingest soil as a source of minerals.

Inhalation (vapors): Inhalation of organic vapors would be limited to those contaminants with relatively high vapor pressures (Henry's Law constant > 10^{-4}). Animals that have the greatest potential for exposure would be those in burrows, such as shrews. Quantification of exposure due to inhalation was performed for compounds with inhalation toxicity information available and with the greatest concentrations (Table 6-H-

5). These calculations were done using equations developed for inhalation exposure for burrowing animals (Hope, 1995) and all resulted in potential risks that were several orders of magnitude lower than risks from soil ingestion and from eating contaminated plants and animals. Thus, inhalation was not considered to be a significant contributor to risk, and this pathway is not considered.

Food Web Interactions: Indirect exposure pathways involve contaminants that biomagnify within the food chain. Contaminants bound to soil or sediment are assumed to be bioavailable only after they partition into the water phase. Water-borne contaminants may bioaccumulate into plant tissues in contact with soil, sediment, or surface water or into terrestrial or aquatic species ingesting soil, sediment, or surface water. As these plants and/or animals are consumed, contaminants may be passed up the food chain to impact organisms within higher trophic levels.

Exposure pathways that were determined to be relevant include root contact for plants, consumption of soil, and biomagnification within the food chain.

6.5.3.1.4 Ecological Receptor Identification

In March, 1992, a terrestrial/riparian reconnaissance survey was conducted at the Site (IT, 1992). The terrestrial survey identified twenty-eight species of upland plants and twenty-six species of riparian/wetland plants at and near the Site. Twenty-six species of birds were identified as well. These included the great blue heron (*Ardea herodias*), mallard duck (*Anas platyrhynchos*), and red-tailed hawk (*Buteo jamaicensis*). Five mammal species were identified, including the Eastern gray squirrel (*Sciurus carolinensis*) and the raccoon (*Procyon lotor*). A terrestrial wildlife and plant species inventory is provided in Table 6-H-1. Three representative species were selected for evaluations:

- a small mammal (deer mouse, *Peromyscus* sp.), not found in survey, but probably present,
- a large terrestrial omnivore and protected species (red-tailed hawk), and
- a large terrestrial omnivore (raccoon).

The Production Area is a former industrial operations center, surrounded on all sides by barren ground, roads, industrial buildings, and residential areas. Its historic use as an industrial site and parking lot, highly compacted soils, sparse cover, various man-made structures, and chain-link fences has eliminated habitats and natural communities that might attract or shelter a variety of

species. This flat site harbors many exotic weed and grass species typical of disturbed habitats and is largely devoid of native vegetation. Potential receptors in the cleared and paved portions of the Production Area include exotic plant species, small mammals (rats, mice, voles, etc.), and terrestrial invertebrates (insects, earthworms) that can tolerate disturbed, human-dominated habitats. Other potential receptors include a few higher trophic level species (such as the red-tailed hawk or raccoon) for which these species are prey. Therefore, representative species for this Area are the deer mouse, raccoon, and red-tailed hawk.

6.5.3.1.5 Potential Adverse Ecological Effects

For adverse ecological effects to be possible, a study site must:

- contain COPCs in abiotic media at detectable and biologically significant concentrations,
- provide exposure pathways linking contaminants to receptors, and
- have ecological receptors that either utilize the site, are present nearby, or are in range of COPCs migrating from the site.

If these three fundamental conditions cannot be met, the probability of adverse effects due to site-related contaminants is minimal.

It has been shown that the Production Area contains COPCs in surface soils and provides exposure pathways potentially linking these COPCs to both on-site and off-site ecological receptors. Onsite bioaccumulation may be providing an exposure pathway to off-site receptors. Figure 6-9 illustrates a simplified food web pathway.

6.5.3.1.6 Endpoints

The potential for adverse effects was addressed in this assessment through comparison of observed exposure point concentrations to the No Observed Adverse Effects Level (NOAEL) for terrestrial animals (see Section 6.5.5.1). A NOAEL is the dose or concentration at or below which no adverse effects have been observed in exposed animals and is one to which a population of organisms may be exposed with no expected adverse impacts on any individuals. A NOAEL is an acceptable level for this assessment.

6.5.3.2 Waste Water Treatment Area

6.5.3.2.1 Site Description

This is a roughly square area which borders the Pawtuxet River to the south and is directly across

the river from the eastern end of the Warwick Area. It has no direct connection to either the Production or Warwick Areas. Its total areal extent is approximately 5.18 ac, of which 0.79 ac is a woodland, 0.54 ac is grassland, 0.25 ac is a seep area, 0.10 ac is paved, and the remainder 3.54 ac is cleared, open ground. Land use as a percentage of total area is woodland, 15.3%; pavement, 1.2%; grassland, 10.4%; seep area, 4.8%; and cleared ground, 68.3%. Much of the cleared land has experienced revegetation by a variety of grass and shrub species; several large trees remain in cleared areas along the river shoreline. The Pawtuxet River fronts the Area for approximately 179 m (590 feet).

6.5.3.2.2 Stressor Selection

COPCs for the Waste Water Treatment Area surface soils, identified using the process described in Section 6.5.5.3.1, are shown in Tables 6-18, 6-H-6 and 6-H-7. COPCs for the seep sediments and surface water are shown in Tables 6-19, 6-H-8, 6-H-9, and 6-H-10.

6.5.3.2.3 Exposure Pathway Identification

Primary and secondary exposure pathways for the Warwick Area are similar to those identified in Section 6.5.3.1.3. However, the seep area also provides a semi-terrestrial exposure pathway that is possible.

6.5.3.2.4 Ecological Receptor Identification

Although the Waste Water Treatment Area is a former industrial operations center, all significant structures have been removed and the Area now encompasses several habitats and natural communities that might attract or shelter a variety of terrestrial species. The woodland edge habitat along the northern boundary may be capable of providing shelter to a number of species; potential receptors in this wooded habitat include terrestrial invertebrates, birds, squirrels, and raccoons. Potential receptors in the grassland and revegetated (cleared) portions of the Area include exotic plant species, small mammals (rats, mice, voles, etc.) and terrestrial invertebrates (insects, earthworms) that can tolerate disturbed, human-dominated habitats. Other potential receptors also include a few higher trophic level species (such as the red-tailed hawk or raccoon) for which these species are prey. In the small seep area (0.25 ac), the amount of standing water appears to vary. As the water recedes, the exposed sediments become part of the terrestrial components. As the standing water increases, those sediments become part of the aquatic pathway. There are no fish in the seep but tadpoles were found. Therefore, the food pathway would be frogs. The great blue heron was chosen as the primary receptor for the seep because it

is at a high tropic level and occurs on-site. The representative species for this Area are the deer mouse, raccoon, red-tailed hawk, and great blue heron.

6.5.3.2.5 Potential Adverse Ecological Effects

It has been shown that the Waste Water Treatment Area contains COPCs in surface soils and in the seep area sediments and water at detectable concentrations and provides exposure pathways linking these COPCs to both on-site and off-site ecological receptors. Onsite bioaccumulation may be providing an exposure pathway to off-site receptors.

6.5.3.2.6 Endpoints

Endpoints for risk assessment at this Area are the same as those described in Section 6.5.3.1.6.

6.5.3.3 Warwick Area

6.5.3.3.1 Site Description

This is an east-west trending roughly rectangular area which parallels Vine Street on the south and borders the Pawtuxet River to the north. The Area protrudes southward across Vine Street for approximately 81m (270 feet). Its total areal extent is approximately 17.17 ac, of which 3.94 ac) is a woodland, 10.17 ac is paved, and the remainder 3.06 ac is cleared, open ground. Land use as a percentage of total area is woodland, 23.0%; pavement, 59.2%, and cleared ground, 17.8%. Much of the cleared land has experienced revegetation by a variety of herbaceous and shrub species; several large trees remain in cleared areas along the river shoreline. The Pawtuxet River fronts the Area for approximately 390 m (1300 feet). Pedestrian and combined railroad/vehicle bridges cross the river to connect this Area with the Production Area.

6.5.3.3.2 Stressor Selection

COPCs for the Warwick Area, identified using the process described in Section 6.5.5.3.1, are shown in Tables 6-18, 6-H-11, and 6-H-12.

6.5.3.3.3 Exposure Pathway Identification

Primary and secondary exposure pathways for the Warwick Area are identical to those identified in Section 6.5.3.1.3. However, this site contains a woodland and supports more animals than the Production Area. Within the woodland is a solid waste management unit (SWMU-5), which contains most of the COPCs found in the Warwick Area. SWMU-5 and an adjacent zinc oxide

soil storage pile (SWMU-6) will be removed by interim remedial actions, thus removing this exposure pathway. However, the risk assessment is performed assuming that the current levels of contamination will continue to exist.

6.5.3.3.4 Ecological Receptor Identification

The Warwick Area is a former administration and engineering operations center, now largely covered by abandoned parking lots, roads, highly disturbed and compacted soils, and various chain-link fences. Over approximately two-thirds of this Area, these historic actions have eliminated habitats and natural communities that might attract or shelter a variety of terrestrial species. It is unlikely that significant numbers of potential receptors would be found in the paved portions due to the lack of habitat. However, natural revegetation in some of the cleared portions has created habitat for some species. The eastern third of the Area is covered with woodland habitat capable of providing shelter to a number of species; potential receptors in this wooded habitat include terrestrial invertebrates, birds, squirrels, and raccoons. Potential receptors in the revegetated (cleared) and paved portions of the Area may include exotic plant species, small mammals (rats, mice, voles, etc.) and terrestrial invertebrates (insects, earthworms) that can tolerate disturbed, human-dominated habitats. Receptors might also include a few higher trophic level species (such as the red-tailed hawk or raccoon) for which these species are prey. Therefore, the representative species are the deer mouse, raccoon, and red-tailed hawk.

6.5.3.3.5 Potential Adverse Ecological Effects

It has been shown that the Warwick Area contains COPCs in surface soils at detectable concentrations and provides exposure pathways linking these COPCs to both on-site and off-site ecological receptors. Onsite bioaccumulation may be providing an exposure pathway to off-site receptors.

6.5.3.3.6 Endpoints

Endpoints for risk assessment at this Area are the same as those described in Section 6.5.3.1.6.

6.5.3.4 Problem Formulation Summary

A summary of problem formulation results for all Areas appears in Table 6.20. Conceptual modeling suggests that COPCs in surface soils in each Area of the Site could be contributing to the potential for adverse effects in ecological receptors utilizing or traversing these Areas. Lower trophic level terrestrial plant and wildlife species are directly exposed to COPCs in surface soils, while higher trophic level receptors (e.g., raccoon, red-tailed hawk, great blue heron) may be

exposed to COPCs bioconcentrated in their prey species (terrestrial invertebrates, small mammals, aquatic vertebrates).

6.5.4 Exposure Characterization

The COPCs identified in Table 6-18 and 6-19 are evaluated as to their potential to affect the site-representative organisms: deer mouse, raccoon, red-tailed hawk, and great blue heron. Potential doses to these organisms are calculated.

6.5.4.1 Production Area

For the purposes of this assessment, tissue residue levels were estimated for terrestrial plants and invertebrates and applied daily doses were estimated for deer mice, red-tailed hawks, and raccoons. Figure 6-9 indicates the feeding relationships for which quantitative exposure estimates were made. Vegetation and insects were assumed to be exposed primarily through root uptake and direct contact with COPCs in surface soils and these COPCs were bioaccumulated when these organisms were eaten by higher trophic-level species. Higher trophic level species in the terrestrial food web (e.g., red-tailed hawk and great blue heron), not necessarily in direct contact with contaminated media, were assumed to be exposed primarily through consumption of contaminated prey. Intake from direct consumption of, or contact with, contaminated surface water, or from inhalation of contaminated dust or vapors, was assumed to be negligible.

Life history parameters required for model calculations are shown in Table 6-21. Species-specific models are described below.

Terrestrial Plants: Toxicant concentrations in reproductive tissues of terrestrial vegetation were calculated using an equilibrium partitioning model (Landrum et al., 1992), as follows:

$$C_{pl} = C_{soil} \times B_r$$

where:

C_{pl} = concentration of toxicant in terrestrial vegetation, mg/kg
C_{soil} = concentration of toxicant in surface soil, mg/kg
B_r = toxicant-specific soil to reproductive vegetation transfer coefficient, unitless (see Table 6-H-13)

Soil to vegetation transfer coefficients for inorganic chemicals (B_r) were obtained from Baes et al. (1984). Organic chemicals were calculated using Travis and Arms (1988):

$$log\ (B_r) = 1.588 - 0.578 \times log\ (K_{ow})$$

where:

K_{ow} = octanol/water partition coefficient for toxicant, unitless (see Table 6-H-13).

Terrestrial Invertebrates: Insect species (terrestrial macroinvertebrates) were assumed to be primarily exposed though direct consumption of terrestrial vegetation; pathways involving surface water consumption, inhalation, or incidental consumption of soil were assumed to be of negligible significance, so that:

$$C_i = \left(\frac{\alpha \times \left(C_{pl} \times F_{pl} \right) \times \frac{R_i}{W_i}}{K_e} \right) \Theta_i \times \Psi_i$$

and

$$R_i = 0.136 \times W_i$$

where:

C_i = terrestrial insect tissue contaminant concentration (absorbed dose), mg/kg

C_{pl} = concentration of toxicant in terrestrial vegetation, mg/kg

F_{pl} = dietary fraction of terrestrial vegetation, unitless

Θ_i = area use factor for terrestrial insects, unitless

Ψ_i = seasonality factor for terrestrial insects, unitless

k_e = toxicant-specific loss rate, day^{-1}

α = species-specific assimilation factor, unitless

R_i = food intake rate, wet diet, kg/d

W_i = body weight of terrestrial insect, kg

The calculation of R_i was performed by assuming that the herbivorous insect ingestion rate is equivalent to approximately 13.6% of insect body weight per day (Crossley and Howden, 1961).

Assimilation efficiency (α) is an estimate of the ratio of the quantity of contaminated material consumed (in food or water) by an organism to the quantity of contaminant actually incorporated into its tissues. Species-specific values for these factors are scarce in the literature. For lipophilic organic COPCs, α was assigned a conservative default values of 0.9 to provide a reasonable maximum estimate of contaminant uptake; this assumption is likely to produce an overestimate of contaminant loading. Inorganic COPCs (those other than organometallic or methylated forms) were assigned assimilation coefficients as follows:

Ba	=	0.10
Be	=	0.001
Cd	=	0.06
CN^-	=	0
Cr^{+3}	=	0.01
Cu	=	0.5
Hg	=	0.15
Ni	=	0.05
Zn	=	0.5

(after Owen, 1989)

The k_e parameter represents the rate at which assimilated COPCs are released from tissues and is included to show recognition of such a process. However, because estimation of this parameter for wildlife species is highly problematic, it was assigned a default value of 1.0 in all calculations and is not shown in the following equations.

When a terrestrial receptor's foraging area exceeds the area of contamination, an area use factor (Θ) is included to account for the effect of receptor mobility on frequency and duration of contact with contaminated media or prey. This factor is defined as the ratio of contaminated area to foraging area for a given indicator species, so that $1 \geq \Theta > 0$ (DeSesso and Price, 1990). An animal whose home/foraging range is very small in comparison to an Area or which is assumed to be a permanent resident of an Area will have an assigned area use factor of 1.0. Because several indicator species are migratory and not continuously present at the Site or are not active throughout the year, an indicator species seasonality factor (Ψ) is defined to account for effects

of receptor seasonality on frequency and duration of contact with contaminated media or prey. This factor is defined as the ratio of the time spent at the Site (in months) to 12, so that $1 \geq \Psi > 0$.

Deer Mouse: Tissue residue concentrations in, and doses received by, deer mice through consumption of contaminated prey items and incidental ingestion of contaminated soils were determined as follows (USEPA, 1993b):

$$C_{dm} = \left(\alpha \times \left(C_i \times F_i + C_{pl} \times F_{pl} + C_{soil} \times F_{soil} \right) \left(\frac{R_{dm}}{W_{dm}} \right) \right) \Theta_{dm} \times \Psi_{dm}$$

and:

$$D_{dm} = \left(\left(C_i \times F_i + C_{pl} \times F_{pl} + C_{soil} \times F_{soil} \right) \left(\frac{R_{dm}}{W_{dm}} \right) \right) \Theta_{dm} \times \Psi_{dm}$$

where:

C_i = terrestrial insect tissue contaminant concentration (absorbed dose), mg/kg
C_{dm} = concentration of toxicant in deer mouse tissue, mg/kg
D_{dm} = applied daily dose for deer mouse, mg/kg-d
F_i = dietary fraction of terrestrial insect, unitless
C_{soil} = concentration of toxicant found in soil, mg/kg
C_{pl} = concentration of toxicant in terrestrial vegetation, mg/kg
F_{pl} = dietary fraction of terrestrial vegetation, unitless
F_{soil} = dietary fraction of soil, unitless
Θ_{dm} = area use factor for deer mouse, unitless
Ψ_{dm} = seasonality factor for deer mouse, unitless
R_{dm} = deer mouse food intake rate, wet diet, = $0.0687 \times W_{dm}^{0.822}$ kg/d (USEPA, 1993b)
W_{dm} = body weight of deer mouse, kg

Red-Tailed Hawk: Doses received by red-tailed hawks through consumption of contaminated prey items were determined as follows (USEPA, 1993):

$$D_{hk} = C_{dm} \times F_{dm} \left(\frac{R_{hk}}{W_{hk}} \right) \Theta_{hk} \times \Psi_{hk}$$

where:

D_{hk} = applied daily dose for red-tailed hawk, mg/kg-d
F_{dm} = dietary fraction of rodents, unitless
Θ_{hk} = area use factor for hawk, unitless
Ψ_{hk} = seasonality factor for hawk, unitless
R_{hk} = hawk food intake rate, wet diet, = $0.0582 \times W_{hk}^{0.651}$ kg/d
W_{hk} = body weight of hawk, kg

Raccoon: Doses received by, raccoons through consumption of contaminated prey items and incidental ingestion of contaminated soils were determined as follows:

$$D_{rc} = \left(C_{dm} \times F_{dm} + C_i \times F_i + C_{pl} \times F_{pl} + C_{soil} \times F_{soil}\right) \left(\frac{R_{rc}}{W_{rc}} \right) \Theta_{rc} \times \Psi_{rc}$$

where:

D_{rc} = applied daily dose for raccoon, mg/kg-d
C_{dm} = concentration of toxicant in deer mouse tissue, mg/kg
F_{dm} = dietary fraction of rodents, unitless
C_i = terrestrial insect tissue contaminant concentration (absorbed dose), mg/kg
F_i = dietary fraction of terrestrial insect, unitless
C_{soil} = concentration of toxicant found in soil, mg/kg
F_{soil} = dietary fraction of soil, unitless
Θ_{rc} = area use factor for raccoon, unitless
Ψ_{rc} = seasonality factor for raccoon, unitless
R_{rc} = raccoon food intake rate, wet diet, = $0.0687 \times W_{rc}^{0.822}$ kg/d (USEPA, 1993b)
W_{rc} = body weight of raccoon, kg

Tissue concentrations in plants and insects, and potential applied daily doses to mice, hawks, and raccoons are shown in Table 6-22.

6.5.4.2 Waste Water Treatment Area

Models and assumptions used in the Production Area are also used in the Waste Water Treatment Area. In addition, an exposure pathway to the great blue heron is used because this aquatic bird could possibly use the seep area as a forage area.

The estimated daily dose received by the great blue heron through consumption of contaminated prey was determined as follows:

$$D_{gbh} = \left(\frac{\left(C_{pw} \times BCF\right) R_h \times \alpha \times F_{aq}}{BW_h} \right) \Theta$$

where:

C_{pw} = Concentration in pore water, mg/l

BCF = COPC-specific bioconcentration factor

R_h = great blue heron food ingestion rate = $0.648 \times BW^{0.651} = 0.118$ kg/day (USEPA, 1993b)

α = COPC-specific assimilation efficiency; assigned as described in Section 6.5.4.1

F_{aq} = fraction of aquatic/semi-terrestrial species in diet = 1.0 for great blue heron

BW_h = median adult great blue heron body weight = 3.0 kg (USEPA, 1993)

Θ = area use factor for heron, unitless

The bioconcentration factor values for inorganic COPCs were obtained from USEPA (1986), and were calculated for organic COPCs as follows (Lyman, et al., 1982):

$$Log\ (BCF) = 0.76 \times Log\ (K_{ow}) - 0.23$$

where:

K_{ow} = COPC-specified octanol-water partitioning coefficient (see Table 6-H-13). The pore water concentration (C_{pw}) was estimated as follows:

$$C_{pw} = \frac{C_{sed}}{K_{oc} \times f_{oc}}$$

where:

K_{oc} = soil/water partitioning coefficient normalized for organic carbon (unitless)

f_{oc} = fractional organic melts content of the sediment (estimated from total organic carbon results for surface soil in the Waste Water Treatment Area)

C_{sed} = concentration of toxicant in the sediment, mg/kg

Soil/water partition coefficients normalized for organic carbon for metals were calculated using the relationship:

$$K_{oc} = K_d/f_{oc}$$

where:

K_d = soil sorption coefficient (from Baes, et al., 1984)

Partition coefficient values for organic COPCs were calculated as follows (USEPA, 1993c):

$$log\ (K_{oc}) = 0.00028 - 0.983 \times log\ (K_{ow})$$

The estimated daily dose received by the great blue heron through consumption of drinking water was determined as follows:

$$D_{dw}=C_{sw} \times WR_h \times F_w$$

where:

D_{dw} = dose received from drinking water, mg/day

C_{sw} = concentration in surface water, mg/l

WR_h = water intake rate = $0.059 \times BW_h^{0.67}$ = 0.123 liters/day

F_w = fraction of water intake supplied by seep, 0.001

Tissue concentrations in plants and insects, and potential applied daily doses to mice, raccoons, and hawks are shown in Table 6-23. This evaluation assumes the seep area sediment is part of the terrestrial surface soils, since this seep area probably shrinks in size during dry seasons.

Potential applied daily doses to the great blue heron are shown in Tables 6-24 and 6-25. This evaluation assumes the seep area sediment is part of the seep, and the COPCs that it contains are available for bioaccumulation in the semi-terrestrial pathway.

6.5.4.3 Warwick Area

Models and assumptions used in the Production area are also used in the Warwick Area. SWMU-5 and SWMU-6 contain the majority of COPCs. These SWMUs represent about 10,000 ft^2, or about 1.3 percent of the Warwick Area, and about 5.8 percent of the habitat available to the biota in the Area. Tissue concentrations in plants and insects, and potential applied daily doses to mice, hawks, and raccoons are shown in Table 6-26.

6.5.5 Risk Characterization

Risk characterization quantitatively defines the magnitude of potential risks to ecological receptors under a specific set of circumstances. It is the process of applying numerical methods and professional judgement to determine whether adverse effects are occurring or are likely to occur due to the presence of COPCs at a given study site. This section addresses the following questions:

- Are ecological receptors currently exposed to site-related stressors at levels capable of causing harm, or is future exposure likely?
- If adverse ecological effects are observed or predicted, what are the types, extent, and severity of effects?
- What are the principle uncertainties associated with the risk characterization?

6.5.5.1 Risk Estimation Methodology

For all Areas at the Site, risk estimation involved a quantitative comparison of estimated potential applied daily doses with toxicity reference values (TRVs) for selected receptors to identify the potential for occurrence of adverse effects due to direct (dermal exposure) and secondary (consumption of contaminated prey or forage) exposures. Applied daily doses are calculated in Section 6.5. TRVs are equivalent to NOAELs. When data were available concerning toxicity of a COPC to avian or mammalian indicator species, the NOAEL derived from a chronic study using an indicator species or a taxonomically similar species was the preferred test endpoint and was used as the TRV. When literature data (particularly NOAEL values) were not available for a given COPC-indicator species combination, acceptable TRVs were extrapolated from other test endpoints–usually median lethal dose (LD50), median lethal concentration (LC50), lowest observed effect level (LOEL) or lowest observed adverse effect

(LOAEL) values–and from toxicological studies on other, more common, test species. NOAEL values were used directly as TRVs, while any acute effect level (LD50, LC50) was divided by an uncertainty factor of 100 to derive a TRV, and any LOEL or LOAEL was divided by an uncertainty factor of 10 to estimate a TRV (Sloof et al., 1986; Suter, 1993; Urban and Cook, 1986). The TRV was taken to represent an applied daily dose (ug/g-d) at or below which no adverse effects are expected. TRVs derived for avian and mammalian receptors are summarized in Table 6-H-14.

A toxicity quotient (TQ) was calculated to facilitate this comparison, as follows:

$$TQ_{km} = \log\left(\frac{D_k}{TRV_m}\right)$$

where:

TQ_{km} = toxicity quotient for the *k*th indicator species relative to the *m*th COPC

D_k = applied daily dose–from Tables 6-22, 6-23, 6-24, 6-25 or 6-26 for the *k*th indicator species,

TRV_m = toxicity reference value (from Table 6-H-14) for the *m*th COPC.

A TQ does not define dose-response relationships and its numerical value should not be construed as a direct or probablistic measure of risk. It is merely a convenient method for indicating whether dose exceeds acceptable toxicity values. Positive TQ values indicate that exposure is greater than acceptable levels, negative values indicate that it is not, and zero indicates that exposure equals acceptable levels. Each whole integer above zero indicates an order of magnitude increase in the potential for toxic effects. For example, a TQ of 2 shows that the applied daily dose is approximately equal to the LD50 and that severe effects are possible in 50% of the population. A TQ > 0 does not automatically imply potential risk, but values >0 should be used to identify COPCs that require further evaluation.

Cumulative effects of COPCs were evaluated by taking the antilog of each TQ, then summing all of the values to produce an Ecological Toxicity Index (ETI). This approach assumes that the toxic action of all chemicals is the same; thus, toxicity potential is additive. If the ETI is less than 1.0, the probability of an adverse impact is negligible; if the index is between 1.0 and 10.0, adverse impact is possible; if the index is over 10.0, adverse impact is likely (Barnthouse, et al, 1986).

6.5.5.2 Risk Description

Risk description for all Areas involves summarizing and interpreting the ecological significance of any observed or predicted effects and the degree of risk they pose to ecological receptors. Interpretation of ecological significance must take into account such factors as nature and magnitude of effects, spatial and temporal distribution of effects, and the potential for study site recovery. A weight-of-evidence approach is used wherein several qualitative and quantitative lines of evidence are integrated to describe ecological risks posed by each Area of the Site.

6.5.5.2.1 Production Area

Based on modeling of potential applied daily doses (Table 6-22) and a toxicity quotient analysis (Table 6-27), risk estimation identified no COPCs that have potential for adverse effects in the Production Area. No TQ values were above zero.

The ETI for the Production Area is 0.344, 0.002, and 0.003 for the deer mouse, hawk, and raccoon, respectively (Table 6-27). Thus, no cumulative impacts are expected. Planned IRMs will reduce risk even further.

6.5.5.2.2 Waste Water Treatment Area

Based on modeling of applied daily doses (Table 6-23) and a toxicity quotient analysis (Tables 6-28 and 6-29), risk estimation identified no COPCs that have potential for adverse effects. As shown in Tables 6-18 and 6-29, no TQ values were greater than zero. The ETIs for this Area are 1.36, 0.006, 0.004, and 0.6 for the deer mouse, hawk, raccoon, and heron, respectively. Therefore, it is concluded that no significant risks are expected in the representative species.

6.5.5.2.3 Warwick Area

Based on modeling of potential applied daily doses (Table 6-26) and a toxicity quotient analysis (Table 6-30), no COPCs were identified as being a potential risk to receptors. As shown in Table 6-30, no TQ values were greater than zero. The ETIs for this Area are 0.262, 0.001, and 0.016 for the deer mouse, hawk, and raccoon, respectively. Since all ETIs are less than one, no cumulative impacts are expected.

6.5.5.3 Uncertainty Analysis

The primary objective of the Ecological Risk Assessment is to characterize and quantify potential risk to ecological receptors. Estimates of the potential for adverse effects from

exposure to COPCs are often made with incomplete and imperfect data. To ensure protection of ecological receptors, assumptions are made that tend to overestimate risk rather than underestimate risk. The principal sources of uncertainty are described below and should be considered when evaluating the risk assessment results and when formulating risk management decisions.

6.5.5.3.1 COPC Selection Process

The COPC selection process:

- eliminated all compounds that were not detected at a certain level above the maximum blank concentration;
- eliminated all compounds detected less than 5% of the time; and
- eliminated all essential nutrients (except zinc) and water chemistry parameters (e.g.; total alkalinity).

Selected inorganics and PAHs in the three areas were compared to the background concentrations in soils in the nearby area using a *t*-test with separate variances (see Appendix 6-B). If the values for the Site were lower ($p<.05$) than the background values, these were eliminated as COPCs. If site concentrations were higher than background concentrations, or there were no statistical test performed, then the chemicals were considered COPCs. There are no regulatory standards for soil, so ARARs could not be used to screen COPCs. Chemical and physical parameters that are indicators of persistence or mobility were reviewed, but didn't eliminate any compounds.

Uncertainty is introduced in the selection and quantification of the COPCs due to quality and limitations of background data and the impact of nondetects and sample quantitation limits. Inclusion of all chemicals as COPCs, if not treated with the *t*-test statistic, probably results in an overestimate of the number of COPCs. Maximum detected and 95th percentile UCL of the mean concentrations were used as the selected concentration values for dose calculation. These are overestimates of average values. Concentrations that were qualified as estimated values during data validation (J values) were used to derive the selected concentration values; nondetected values were assumed to be one-half the sample quantitation limit (SQL). The use of J values may result in either an overestimate or an underestimate of the actual average concentration. Because many of the J values are less than one half the SQL, the assumption for nondetects that a concentration equal to one-half the SQL is present tends to overestimate the actual average concentration.

6.5.5.3.2 Receptor Selection

The potential suite of receptors was surveyed on a Site-wide basis and not on an Area-specific basis and thus species uniquely associated with a given Area may have been missed. Knowledge of potential ecological receptors is based on a relatively short period of observation during only one season. Rare, sensitive species or protected migratory species may be under represented in the terrestrial species inventory. Indicator species selected for inclusion in the food web model, as well as the structure of the food web itself, are also sources of uncertainty in that they do not necessarily completely represent ecological relationships at the Site. However, the contaminated areas in question are highly disturbed areas and do not include any unique habitat. As such, they are unlikely to harbor any rare, sensitive, or endangered species.

6.5.5.3.3 Exposure Estimation

Exposure estimation process: Using methods developed and accepted by USEPA, the concentration from uptake and ingestion of each compound in plants, insects, and deer mice was estimated. Once concentration was estimated, the estimated daily dose of each compound in the selected ecological receptors (deer mice, red-tailed hawks, raccoons, and great blue herons) was calculated.

Dermal contact was calculated for several highly toxic compounds, including PCBs, that had dermal toxicity data available. The calculation was done for baby shrews since they live underneath the ground and are hairless when born. None of the compounds presented a significant risk when compared to the risk from ingestion, so dermal contact was not considered further.

Inhalation was calculated for compounds for which data were available. The calculation was done for shrews, since they live in burrows in contact with toxicants. None of the compounds presented a significant risk; thus, inhalation was not considered further.

Concentration was calculated for plants, insects, and deer mice, and these values were used to establish a daily dose for deer mice (based on eating plants and insects and ingesting soil); for red-tailed hawks (based on eating deer mice); and for raccoons (based on eating plants, insects, deer mice and ingesting soil). In the Waste Water Treatment Area, the sediment values in the seep area and the biomagnification to aquatic receptors (frogs) were used to establish a daily dose for the great blue heron. If fish had been present it would have resulted in the same bioconcentration factors as frogs.

For concentration, assimilation of the compound was assumed to be 90%, with the exception of some inorganic compounds for which an actual assimilation factor was available. The toxicant specific loss rate (i.e., the rate at which assimilated COPCs are released from tissues) was assigned a default value of 1 since estimation of this parameter is problematic. Thus, concentration in tissues would tend to be over-estimated, resulting in an overestimation of risk.

Other factors that would also reduce exposure values include:

- bioavailability from soil,
- degradation rates in soil,
- metabolic transformation in vegetation or invertebrates,
- receptor avoidance of contaminated soils,
- dilution over distance, and
- frequency of receptor exposure to contaminated media.

These factors were not included in the risk assessment process; thus, risk would tend to be overestimated.

Home ranges for the red-tailed hawk and the raccoon assumed the amount of foraging done in the contaminated areas was 10%. This estimate is high, since the home range for a red-tailed hawk is about one square mile; and for a raccoon approximately 100 to 6000 acres. Areal photograph analysis indicates that the Site is much less than 10 percent of the potential available habitat for these two animals, assuming the Site is in the center of their home ranges. Therefore, any risk to these animals may be overestimated. Forage area for the heron is between 5-7 km for coastal birds. Several hundred acres of heron habitat is found within 5.7 km of the Cranston Site. Since the seep area is only 0.25 acres and has no fish, the heron's primary food, the wetland seep area in the Warwick Area is assumed to represent less than 0.1 percent of available foraging habitat. This value was used when estimating a risk.

Estimates of COPC concentrations in the plants and terrestrial invertebrates do not account for absorption or elimination factors. This is likely to result in an overestimate of tissue residual levels and thus of risk.

6.5.5.3.4 Effects Characterization

Oral NOAEL data for the mouse were the first choice for a mammalian TRV, with the rat and the rabbit being the second choice. If no NOAEL data were available, then LOAEL data were the

next choice and LD-50 data were used if no LOAEL or NOAEL data were found. If no mammal data were available, then data on birds were selected next. If more than one value was found for the selected species, the most conservative value was used. LD-50 data were divided by 100 to estimate an NOAEL. LOAEL data were divided by 10 to estimate an NOAEL. Oral NOAEL data for birds were the first choice for an avian TRV. If no bird data were available, mammalian data were used as described above.

The NOAEL represents the ecotoxicological chronic effect. NOAELs were not available for all compounds and acute effects data was used to establish a TRV. Once a TRV was established, the daily dose was divided by the TRV and the log value was derived. Anything greater than 0 would be considered a potential risk.

Uncertainty is introduced in this calculation in several ways. The TRV's are based on data obtained for single species under laboratory conditions, as opposed to field conditions. Using similar species lowers the uncertainty, but data for similar species is not always available. Extrapolating chronic effects (NOAEL) from acute effects data (LOAEL, LD-50) is another source of uncertainty. High doses that induce acute effects do not always produce chronic effects at lower levels. Uncertainty arises from the practice of extrapolating an acceptable TRV from acute effects data (LOAEL, LD50, LC-50) by use of an uncertainty factor. Estimating NOAEL tends to overestimate risk. Chemicals for which toxicity data is unavailable further increases the uncertainty. Additionally, comparison of TRVs to the upper 95% confidence interval of the mean concentration is inherently conservative and will tend to overestimate both exposure levels and risk.

As an additional evaluation, the daily doses divided by the TRVs were added together to determine cumulative effects from exposure to many different chemicals. This scenario assumes that the effects caused by the chemicals are additive. There is also the possibility that the effects of exposure to multiple chemicals could be antagonistic or synergistic without additional information, assuming additive effects are probably appropriate.

Due to the availability of data, impacts to individual organisms are considered in this ecological risk assessment, rather than impacts to populations. For the deer mouse, population effects in the Warwick Area were approximated because there is enough habitat to support a population. The home range of a deer mouse is only 1/3 acre. Since the contaminated area in the Warwick Area is only 1/4 acre and represents only about 3.5 percent of deer mouse habitat, most of the

individual deer mice will not come in contact with contamination. Therefore, risks to deer mice in the Warwick area are calculated for the individual then translated into a population effect. Risk to deer mice in the other areas are calculated for the individual only, since contamination is not as isolated and each mouse could be affected. Generally, except for threatened and endangered species, assessments need only to evaluate population effects. Evaluating risks to individuals tends to overestimate risk to both populations and communities (USEPA, 1989b).

Regulatory standards were unavailable for all the compounds and toxicological data was unavailable for a total of six compounds. These data gaps may cause an underestimate of risk, since unevaluated COPCs could be unrecognized sources of risk. The toxicological data could over- or underestimate risk. Other toxicological factors, such as interactions between chemicals, synergism, etc. may also influence effect, but these factors are extremely difficult to assess for wildlife receptors.

6.5.5.3.5 Risk Characterization

Uncertainty arises in comparing the exposure (daily dose) to the effect (TRV). Both of these represent a population with a unique set of statistical characteristics, strongly influencing the assessment of risk and the quantification of uncertainty. Uncertainty also arises when the uncertainty of the exposure assessment is combined with the uncertainty of the effects assessment, producing a multiplicative bias toward a conservative outcome.

Uncertainty inherent to the risk characterization process for assessment of cumulative effects involves the additive assumption of adverse health effects associated with different chemicals. Chemicals in combination may act additively, antagonistically, synergistically, or not influence each other at all. Therefore, the assumptions of additivity used to predict cumulative effects may either overestimate or underestimate ecological risk.

The COPCs identified in this report are not the only source of stress to the Areas investigated. Mechanical disturbance and destruction of habitat, close proximity of human activities, and atmospheric deposition of non site-specific contaminants (particularly polycyclic aromatic hydrocarbons (PAHs) may all contribute to the stresses endured by the ecological receptors in each area of the Site.

6.5.5.4 Conclusions and Recommendations

6.5.5.4.1 Production Area

COPCs are not present in surface soils at concentrations potentially capable of inducing adverse effects; i.e., their toxicity quotient values are less than 0, and thus the Production Area meets the assessment endpoint for terrestrial wildlife. The ETIs do not exceed 1.0.; thus, potential additive adverse effects are negligible. In other words, the presence of site-related chemicals does not appear to pose an unacceptable risk to terrestrial receptors.

6.5.5.4.2 Waste Water Treatment Area

COPCs are not present in surface soils or seep area sediments at concentrations potentially capable of inducing adverse effects; i.e. their toxicity quotient values are less than 0, thus the Waste Water Treatment Area meets the assessment end point for terrestrial wildlife. One ETI for deer mice barely exceeds 1.0 (1.26) and is less than 1.0 for the other representative species. Therefore, potential cumulative effects are not expected. Cumulative effects are likely only if the ETI exceeds 10.0.

6.5.5.4.3 Warwick Area

COPCs are not present in surface soils or seep area sediments at concentrations potentially capable of inducing adverse effects; i.e. their toxicity quotient values are less than 0, thus the Warwick Area meets the assessment end point for terrestrial wildlife. One ETI for deer mice does not exceed 1.0 for the other representative species. Therefore, potential cumulative effects are not expected. Cumulative effects are likely only if the ETI exceeds 10.0.

6.6 Proposed Media Protection Standards

The PHERE provides estimates of potential risks for the Cranston Site using the conservative guidance provided during the May, 1994, meeting with Region I and other meetings and teleconferences. The approach taken is biased towards overestimating risk. For example, all of the risk estimates are based on calculations using the 95 percent UCL of mean chemical concentrations instead of the actual mean. Even with this conservative approach, neither the Production, Waste Water Treatment, nor Warwick Area is predicted to pose an unacceptable potential risk. This was found in spite of the biased sampling approach used in the field investigations that targeted highly localized areas of suspected contamination. The Warwick Area could be an exception but only under the USEPA-imposed assumption that all PCBs are treated as if they were the carcinogenic PCB 1260. No PCB 1260 was found in the Warwick Area.

PCBs are widespread in the Production Area as evidenced by the 89 percent frequency of detection for PCB 1254 and 39 percent for the PCB 1248 in surface soil samples (Appendix 6-A). The risk assessment model for the on-site worker scenario (that is a combination of all the exposure assumption values, environmental transport models, and toxicity criteria used in the risk assessment) can be used to estimate risk-based MPS values for PCB 1248 and PCB 1254. Under these circumstances, the MPSs would be used to identify "hot spots" and their removal considered, even though there are no unacceptable risks. Estimating an MPS is accomplished by beginning with the target THI value of 1 and "back-calculating" through the risk assessment model to the respective surface soil concentrations (Appendix 6-G). Estimated MPS values can be used to compare with the highest concentrations in the Production Area to determine if there are specific zones where PCB concentrations are higher than the MPSs. The estimated MPS value is 50 mg/kg (ppm) for both PCB 1248 and 1254 using the approach described above. Potential additivity of PCB health effects are taken into account in these proposed MPSs, so these values are applicable to all PCBs detected on-site.

A similar approach to estimating MPS values can be taken for the Warwick Area even though PCBs are obviously not as widespread there as in the Production Area with a frequency of detection for PCB 1248 in surface soil of 9 percent and for PCB 1254 of 47 percent (Appendix 6-A). Also, most of the attention in the field investigation was concentrated on SWMU-5. It contains a highly localized remnant of dredge materials from Pawtuxet River sediments taken from a waste water outfall and Cofferdam area immediately adjacent to the Ciba Facility.

Therefore, surface soil MPS values specific to the resident scenario for the Warwick Area would be useful to compare to PCB concentrations found in SWMU-5. Furthermore, residential may not be the most likely land use for this area. The risk assessment model for the resident scenario is used to "back-calculate" MPSs for the PCBs. The estimated surface soil MPS is 5 ppm for PCBs. Potential additive toxicity of PCB 1248 and PCB 1254 is accounted for in these proposals (actually, since PCB 1248 is less toxic than PCB 1254 the MPS value for PCB 1248 alone is 24 ppm).

This PHERE shows that corrective actions are not necessary for the three site areas solely on the basis of unacceptable potential risk to public health or the site ecology. However, Ciba began some limited remediation during the IRMs in the Production and Warwick Areas for reasons other than potential risk; specifically, to facilitate productive use of the areas. Therefore, the risk-based total PCB surface soil MPS proposed for hot spot removal in the Production Area is 50 ppm, and for the Warwick Area is 5 ppm.

PCBs are not even a remote concern in the Waste Water Treatment Area, since they were detected in only two of 31 samples and at concentrations below 1 ppm.

Ciba identified a zone where soil concentrations of PCBs were consistently above 50 ppm in the production area. The presence of this zone of PCB contamination was not a realistic public exposure concern because of the proposed use of this property as a paved vehicle parking facility. However, Ciba volunteered to remove PCB-contaminated surface soil to facilitate its productive use (IRM Work Plan submitted in March, 1995, to Region I).

Similarly, SWMU-5 (Figure 6-1) in the Warwick Area had soil PCB concentrations that were consistently above the 5 ppm MPS. This area is not a realistic exposure concern for the resident scenario because of the highly localized nature of this PCB contamination. However, Ciba volunteered to remove PCB-contaminated soil from the SWMU-5 area (IRM Work Plan submitted to March, 1995, to Region I).

Table 6-1
Comparison of Production Area Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in Surface Soil with those of Near-Site Background Surface Soil

Chemical	Production Area						Near-Site Background						Urban Background
	Detection/ Total Samples	Frequency of Detection (%)	Minimum Det. Conc. (mg/kg)	Maximum Det. Conc. (mg/kg)	Mean Conc. (mg/kg)	95th UCL [a] (mg/kg)	Detection/ Total Samples	Frequency of Detection (%)	Minimum Det. Conc. (mg/kg)	Maximum Det. Conc. (mg/kg)	Mean Conc. (mg/kg)	95th UCL [a] (mg/kg)	Typical Concentration (mg/kg)
2- Methylnaphthalene	4/41	9.8	0.038	0.38	1.3	1.7	2/12	17	0.57	4.5	0.66	1.3	NA[b]
Acenaphthene	10/41	24	0.057	0.21	1.2	1.7	5/12	42	0.031	5.4	0.69	1.5	NA
Acenaphthylene	5/41	12	0.043	0.18	1.3	1.7	4/12	33	0.044	0.61	0.30	0.4	NA
Anthracene	24/41	59	0.034	1.6	0.88	1.3	7/12	58	0.041	20	2.2	5.1	NA
Benzo(a)anthracene	28/41	68	0.15	3.1	1.1	1.5	7/12	58	0.28	28	3.2	7.4	20[c]
Benzo(a)pyrene	27/41	66	0.024	3.1	1.3	1.7	8/12	67	0.13	22	2.6	5.8	50-75[d]
Benzo(b)fluoranthene	30/41	73	0.027	4.3	1.6	2.0	9/12	75	0.026	36	4.2	9.5	NA
Benzo(g,h,i)perylene	21/41	51	0.13	2.9	1.4	1.8	8/12	67	0.080	12	1.6	3.3	100[e]
Benzo(k)fluoranthene	27/41	66	0.074	5.5	1.5	1.9	8/12	67	0.079	43	4.7	11	NA
Chrysene	28/41	68	0.15	3.3	1.2	1.6	9/12	75	0.14	30	3.4	7.9	20[d]
Dibenz(a,h)anthracene	10/41	24	0.046	0.68	1.2	1.7	3/12	25	0.12	3.7	0.61	1.1	NA
Fluoranthene	33/41	80	0.051	8.4	1.6	2.1	12/12	100	0.043	57	6.6	15	5-120[d]
Fluorene	12/41	29	0.048	0.18	1.2	1.7	5/12	42	0.053	9.4	1.1	2.5	NA
Indeno(1,2,3-cd)pyrene	21/41	51	0.045	2.3	1.3	1.8	7/12	58	0.23	14	1.8	3.9	NA
Naphthalene	14/41	34	0.033	0.68	0.83	1.3	4/12	33	0.023	7.3	0.86	1.9	NA
Phenanthrene	28/41	68	0.093	5.0	1.1	1.5	11/12	92	0.052	69	7.2	17	NA
Pyrene	32/41	78	0.061	6.7	1.8	2.3	12/12	100	0.038	56	6.3	15	5-120[d]

Table 6-1
Comparison of Production Area Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in Surface Soil with those of Near-Site Background Surface Soil

Chemical	Production Area						Near-Site Background						Urban Background
	Detection/ Total Samples	Frequency of Detection (%)	Minimum Det. Conc. (mg/kg)	Maximum Det. Conc. (mg/kg)	Mean Conc. (mg/kg)	95th UCL [a] (mg/kg)	Detection/ Total Samples	Frequency of Detection (%)	Minimum Det. Conc. (mg/kg)	Maximum Det. Conc. (mg/kg)	Mean Conc. (mg/kg)	95th UCL [a] (mg/kg)	Typical Concentration (mg/kg)
Total PAHs[f]					22						48		

a. 95th percentile upper confidence limit of the mean concentration.

b. "NA" = Information not available.

c. Source: IRAC, 1973.

d. Source: White and Vanderslice, 1980.

e. Source: Radian Corporation, 1983.

f. The mean concentration for Total PAHs was derived by adding the mean concentration of each individual PAH in the data set.

Table 6-2
Comparison of Waste Water Treatment Area Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in Surface Soil with those of Near-Site Background Surface Soil

Chemical	Waste Water Treatment Area						Near-Site Background						Urban Background
	Detection/ Total Samples	Frequency of Detection (%)	Minimum Det. Conc. (mg/kg)	Maximum Det. Conc. (mg/kg)	Mean Conc. (mg/kg)	95th UCL [a] (mg/kg)	Detection/ Total Samples	Frequency of Detection (%)	Minimum Det. Conc. (mg/kg)	Maximum Det. Conc. (mg/kg)	Mean Conc. (mg/kg)	95th UCL [a] (mg/kg)	Typical Concentration (mg/kg)
2- Methylnaphthalene	0/181	0	ND	ND	ND	ND	2/12	17	0.57	4.5	0.66	1.3	NA[b]
Acenaphthene	1/18	5.6	0.60	0.60	0.77	1.3	5/12	42	0.031	5.4	0.69	1.5	NA
Acenaphthylene	1/18	5.6	0.045	0.045	0.79	1.3	4/12	33	0.044	0.61	0.30	0.4	NA
Anthracene	2/18	11	0.38	0.38	0.73	1.2	7/12	58	0.041	20	2.2	5.1	NA
Benzo(a)anthracene	6/18	33	0.16	3.90	0.86	1.5	7/12	58	0.28	28	3.2	7.4	20[c]
Benzo(a)pyrene	5/18	28	0.046	3.60	0.86	1.5	8/12	67	0.13	22	2.6	5.8	50-75[d]
Benzo(b)fluoranthene	11/18	61	0.081	3.20	1.0	1.6	9/12	75	0.026	36	4.2	9.5	NA
Benzo(g,h,i)perylene	3/18	17	0.30	2.50	0.90	1.4	8/12	67	0.080	12	1.6	3.3	100[e]
Benzo(k)fluoranthene	8/18	44	0.16	3.80	0.95	1.5	8/12	67	0.079	43	4.7	11	NA
Chrysene	9/18	50	0.10	4.10	0.86	1.5	9/12	75	0.14	30	3.4	7.9	20[d]
Dibenz(a,h)anthracene	1/18	5.6	17.00	17.00	1.4	3.0	3/12	25	0.12	3.7	0.61	1.1	NA
Fluoranthene	12/18	67	0.046	6.90	0.81	1.5	12/12	100	0.043	57	6.6	15	5-120[d]
Fluorene	2/18	11	0.11	0.51	0.77	1.3	5/12	42	0.053	9.4	1.1	2.5	NA
Indeno(1,2,3-cd)pyrene	4/18	22	0.12	2.10	0.85	1.4	7/12	58	0.23	14	1.8	3.9	NA

Table 6-2
Comparison of Waste Water Treatment Area Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in Surface Soil with those of Near-Site Background Surface Soil

Chemical	Waste Water Treatment Area						Near-Site Background						Urban Background
	Detection/ Total Samples	Frequency of Detection (%)	Minimum Det. Conc. (mg/kg)	Maximum Det. Conc. (mg/kg)	Mean Conc. (mg/kg)	95th UCL [a] (mg/kg)	Detection/ Total Samples	Frequency of Detection (%)	Minimum Det. Conc. (mg/kg)	Maximum Det. Conc. (mg/kg)	Mean Conc. (mg/kg)	95th UCL [a] (mg/kg)	Typical Concentration (mg/kg)
Naphthalene	9/18	50	0.066	2.50	0.57	0.9	4/12	33	0.023	7.3	0.86	1.9	NA
Phenanthrene	14/18	78	0.049	5.10	0.82	1.4	11/12	92	0.052	69	7.2	17	NA
Pyrene	16/18	89	0049	5.1	1.5	2.4	12/12	100	0.038	56	6.3	15	5-120[d]
Total PAHs[f]					14						48		

a. 95th percentile upper confidence limit of the mean concentration.

b. "NA" = Information not available.

c. Source: IRAC, 1973.

d. Source: White and Vanderslice, 1980.

e. Source: Radian Corporation, 1983.

f. The mean concentration for Total PAHs was derived by adding the mean concentration of each individual PAH in the data set.

Table 6-3
Comparison of Warwick Area Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in Surface Soil with those of Near-Site Background

Chemical	Warwick Area						Near-Site Background						Urban Background
	Detection/ Total Samples	Frequency of Detection (%)	Minimum Det. Conc. (mg/kg)	Maximum Det. Conc. (mg/kg)	Mean Conc. (mg/kg)	95th UCL[a] (mg/kg)	Detection/ Total Samples	Frequency of Detection (%)	Minimum Det. Conc. (mg/kg)	Maximum Det. Conc. (mg/kg)	Mean Conc. (mg/kg)	95th UCL[a] (mg/kg)	Typical Concentration (mg/kg)
2- Methylnaphthalene	6/31	19	0.014	0.36	1.3	2.0	2/12	17	0.57	4.5	0.66	1.3	NA[b]
Acenaphthene	3/31	9.7	0.016	0.16	1.4	2.0	5/12	42	0.031	5.4	0.69	1.5	NA
Acenaphthylene	3/31	9.7	0.061	0.11	1.4	2.0	4/12	33	0.044	0.61	0.30	0.40	NA
Anthracene	10/31	32	0.031	0.32	1.3	2.0	7/12	58	0.041	20	2.2	5.1	NA
Benzo(a)anthracene	15/31	48	0.14	1.6	0.97	1.4	7/12	58	0.28	28	3.2	7.4	20[c]
Benzo(a)pyrene	13/31	42	0.025	1.7	1.2	1.6	8/12	67	0.13	22	2.6	5.8	50-75[d]
Benzo(b)fluoranthene	14/31	45	0.042	2.8	1.2	1.6	9/12	75	0.026	36	4.2	9.5	NA
Benzo(g,h,i)perylene	9/31	29	0.064	1.2	1.4	2.1	8/12	67	0.08	12	1.6	3.3	100[e]
Benzo(k)fluoranthene	13/31	42	0.062	3.6	1.3	1.8	8/12	67	0.079	43	4.7	11	NA
Chrysene	14/31	45	0.12	2.3	1.07	1.5	9/12	75	0.14	30	3.4	7.9	20[d]
Dibenz(a,h)anthracene	3/31	9.7	0.083	0.13	1.4	2.0	3/12	25	0.12	3.7	0.61	1.1	NA
Fluoranthene	17/31	55	0.038	3.7	1.2	1.6	12/12	100	0.043	57	6.6	15	5-120[d]
Fluorene	7/31	23	0.035	0.23	1.3	2.0	5/12	42	0.053	9.4	1.1	2.5	NA

Table 6-3
Comparison of Warwick Area Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in Surface Soil with those of Near-Site Background

Chemical	Warwick Area						Near-Site Background						Urban Background
	Detection/ Total Samples	Frequency of Detection (%)	Minimum Det. Conc. (mg/kg)	Maximum Det. Conc. (mg/kg)	Mean Conc. (mg/kg)	95th UCL[a] (mg/kg)	Detection/ Total Samples	Frequency of Detection (%)	Minimum Det. Conc. (mg/kg)	Maximum Det. Conc. (mg/kg)	Mean Conc. (mg/kg)	95th UCL[a] (mg/kg)	Typical Concentration (mg/kg)
Indeno(1,2,3-cd)pyrene	8/31	26	0.07	0.86	1.4	2.1	7/12	58	0.23	14	1.8	3.9	NA
Naphthalene	16/31	52	0.036	3.5	1.1	1.6	4/12	33	0.023	7.3	0.86	1.9	NA
Phenanthrene	17/31	55	0.18	1.7	0.87	1.1	11/12	92	0.052	69	7.2	17	NA
Pyrene	18/31	58	0.053	3	1.3	1.6	12/12	100	0.038	56	6.3	15	5-120[d]
Total PAHs[f]					21						47.9		

a. 95th percentile upper confidence limit of the mean concentration.
b. "NA" = Information not available.
c. Source: IARC, 1973.
d. Source: White and Vanderslice, 1980.
e. Source: USEPA, 1983.
f. The mean concentration for Total PAHs was derived by adding the mean concentration of each individual PAH in the data set.

Table 6-4
Exposure Assumption Values for Worker and Resident Scenarios

Parameter	Units	Exposure Scenario Values		
		On-Site Worker	General Worker	On-Site Resident
Body Weight (BW)	kg	70[a]	70[a]	70/15[b]
Averaging Time - Noncarcinogenic (AT_n)	days	9,125[c]	9,125[c]	10,950[c]
Averaging Time - Carcinogenic (AT_c)	days	25,550[d]	25,550[d]	25,550[d]
Exposure Frequency (EF)	(events/yr)	80[e]	250[f]	350[g]
Conversion Factor (CF)	(kg/mg)	1×10^{-6}	1×10^{-6}	1×10^{-6}
Exposure Duration (ED)	yrs	25[h]	25[h]	30[i]
Soil Ingestion Rate (IR_s)	(mg/day)	50[j]	50[k]	100/200[l]
Fraction of Soil Originating from Source (FS)	(none)	1.0[m]	1.0[m]	1.0[m]
Inhalation Rate (I_nR)	(m^3/hr)	1.4[n]	1.4[n]	0.6/0.3[o]
Exposure Time (ET)	(hr/day)	8[p]	1.5[q]	17[r]
Body Surface Area Exposed to Soils (SA_s)	(cm^2/event)	5,000[s]	5,000[s]	5,000/2,000[s]
Soil Adherence Factor (AF)	(mg/cm^2)	1[t]	1[u]	1[t]

a. Default value for an adult (USEPA, 1991a).
b. Adult/child default values (USEPA, 1991a).
c. Equals ED x 365 days/yr.
d. Equals a lifetime (70 years x 365 days/yr).
e. 85 winter work days/year (17 weeks or about 4 months), *minus* 5 days vacation and holidays.
f. Five working days per week, 52 weeks per year, *minus* 2 weeks for vacation days, holidays, and other time off work *equals* 250 exposure days for indoor and outdoor inhalation exposure (USEPA, 1991a). 250 working days per year, *minus* 4 months of working days (85 days) during the winter when exposure would be minimal due to less outdoor activity and frozen/covered ground, *equals* 165 days for the ingestion and dermal exposure pathways.
g. 365 days/year *minus* 15 vacation days, holidays, weekend trips *equals* 350 exposure days/year for indoor and outdoor inhalation exposure (USEPA, 1991a). 365 days/year *minus* 120 winter days/year *minus* 15 vacation days, holidays, weekend trips *equals* 230 outdoor exposure days/year for ingestion and dermal exposures.
h. Upper-bound estimate for time at one place of employment (USEPA, 1991a).
i. Upper-bound estimate for time at one residence (USEPA, 1991b).
j. Default value for industrial/commercial occupations (USEPA, 1991a).
k. Default value for industrial/commercial occupations (USEPA, 1991a), prorated to the portion of the working day (1.5 hours) spent doing outdoor activities.
l. Default value for adult/child residents (USEPA, 1991a). Prorated to portion of the day spent at home (17 hours).

Table 6-4
Exposure Assumption Values for Worker and Resident Scenarios

m. Maximum default value (USEPA, 1991a).
n. Value for moderate activity (USEPA, 1991b).
o. Adult (USEPA, 1990a) child (International Commission on Radiation Protection, 1976).
p. Standard workday.
q. Average daily outdoor activity assumed.
r. Mean hours per day spent at home by men and women is 15.4 (USEPA, 1990a).
s. Default value equaling approximately 25% of the body surface area assumed for the summer months, 5% for the winter months, and 10% for the remainder of the year as recommended by the USEPA's dermal exposure guidance (USEPA, 1992).
t. Default value based on adherence of soil to the hands (USEPA, 1992).
u. Default value based on adherence of soil to the hands (USEPA, 1992), prorated to the portion of the working day spent doing outdoor activities.

Table 6-5
Exposure Assumption Values for Canoeist Scenario

Parameter	Units	Value
Body Weight (BW)	kg	70[a]
Averaging Time - Noncarcinogenic (AT_n)	days	10,950[a]
Averaging Time - Carcinogenic (AT_c)	days	25,550[b]
Exposure Frequency (EF)	(events/yr)	8[c]
Exposure Duration (ED)	yrs	30[a]
Exposure Time (ET)	(hr/event)	2[d]
Water Ingestion Rate (IR_w)	(L/event)	0.005[e]
Body Surface Area Exposed to Water (SA_w)	cm^2	2,300[f]

a. Default value for an adult (USEPA, 1991a).

b. Represents a life expectancy of 75 years.

c. Assumes one exposure event per month, excluding four winter months. Winter months are defined as those with a daily mean temperature less than 40°F. Based on data from the National Oceanic and Atmospheric Administration (1990).

d. Assumes reasonable duration for a canoeing event.

e. In a canoeist scenario, little or virtually no water would be ingested (5 ml = 1 teaspoon).

f. Surface area of hands and feet (USEPA, 1990a).

Table 6-6
Potential Upper-Bound Exposure Point Concentrations for Chemicals of Potential Concern and Background Chemicals

PRODUCTION AREA

Chemical	Frequency of Detection (No. of detects/No. of samples)		Concentration			
	Surface Soil	Combined Soil	Surface Soil[a] (mg/kg)	Combined Soil[b] (mg/kg)	Airborne Emissions[c] (mg/m^3)	River Water (mg/l)
COPCs						
PCB-1248	30/101	39/144	127	88	1.6×10^{-5}	7.6×10^{-6}
PCB-1254	94/104	127/149	20	15	7.0×10^{-7}	1.4×10^{-6}
PCB-1260	7/83	15/126	6.1	4.8	1.5×10^{-7}	1.3×10^{-8}
gamma-Chlordane	7/43	13/86	0.13	0.070	5.0×10^{-9}	1.3×10^{-7}
Vinyl chloride	0/40	0/80	ND[d]	ND	NA[e]	2.6×10^{-5}
2-Nitroaniline	8/41	9/84	0.89	4.2	2.4×10^{-6}	4.8×10^{-3}
Toluene	18/40	31/80	0.71	62	1.6×10^{-3}	9.9×10^{-3}
Chlorobenzene	7/40	9/80	0.28	0.28	4.9×19^{-6}	1.2×10^{-3}
BACKGROUND						
Arsenic	29/32	52/55	15	12	5.9×10^{-8}	--[f]
Benzo(a)pyrene	27/41	44/84	1.7	1.1	6.7×10^{-9}	--[f]
Chromium	29/31	52/54	14	12	5.5×10^{-8}	--[f]
Dibenz(a,h)anthracene	10/41	12/84	0.68	0.68	2.7×10^{-9}	--[f]
Vanadium	28/31	45/52	21	16	8.2×10^{-8}	--[f]

Table 6-6
Potential Upper-Bound Exposure Point Concentrations for Chemicals of Potential Concern and Background Chemicals

WASTE WATER TREATMENT AREA

Chemical	Frequency of Detection (No. of detects/No. of samples)		Concentration			
	Surface Soil	Combined Soil	Surface Soil[a] (mg/kg)	Combined Soil[b] (mg/kg)	Airborne Emissions[c] (mg/m^3)	River Water (mg/l)
COPCs						
2,3,7,8 TCDF	2/6	3/7	6.2×10^{-4}	5.4×10^{-4}	7.7×10^{-11}	7.7×10^{-12}
bis(2-ethylhexyl)phthalate	5/18	11/31	2.1	1.4	2.2×10^{-8}	8.6×10^{-6}
Dieldrin	4/18	6/31	0.17	0.13	9.7×10^{-9}	9.1×10^{-8}
gamma-Chlordane	7/21	14/34	3.2	2.2	1.6×10^{-7}	8.6×10^{-8}
PCB 1254	1/18	2/31	0.21	0.21	9.9×10^{-8}	2.8×10^{-9}
Tinuvin 327	2/9	2/15	11	8.2	8.2×10^{-8}	4.9×10^{-7}
BACKGROUND						
Arsenic	15/15	23/23	7.7	6.4	5.8×10^{-8}	--[f]
Benzo(a)pyrene	5/18	8/31	1.5	1.1	1.1×10^{-8}	--[f]
Beryllium	14/15	20/23	0.52	0.56	3.9×10^{-9}	--[f]
Chromium	15/15	23/23	12	10	9.0×10^{-8}	--[f]
Dibenz(a,h)anthracene	1/18	3/31	3.0	1.9	2.2×10^{-8}	--[f]
Manganese	9/9	15/15	273	228	2.0×10^{-6}	--[f]
Vanadium	15/15	23/23	12	10	9.0×10^{-8}	--[f]

Table 6-6
Potential Upper-Bound Exposure Point Concentrations for Chemicals of Potential Concern and Background Chemicals

WARWICK AREA

Chemical	Frequency of Detection (No. of detects/No. of samples)		Concentration			
	Surface Soil	Combined Soil	Surface Soil[a] (mg/kg)	Combined Soil[b] (mg/kg)	Airborne Emissions[c] (mg/m^3)	River Water (mg/l)
COPCs						
PCB-1248	3/34	3/54	15	9.7	1.6×10^{-6}	2.1×10^{-7}
PCB-1254	15/32	17/52	5.2	3.3	1.4×10^{-7}	9.7×10^{-8}
2-Nitroaniline	2/31	3/41	7.0	7.0	3.7×10^{-6}	1.7×10^{-2}
Chlorobenzene	9/32	12/52	0.67	2.7	4.3×10^{-4}	6.1×10^{-4}
Aldrin	3/33	3/53	0.21	0.14	7.4×10^{-9}	3.9×10^{-6}
Beryllium	3/31	43/44	0.82	0.83	2.9×10^{-9}	4.8×10^{-6}
Dieldrin	5/32	6/52	0.16	0.11	7.4×10^{-9}	4.6×10^{-8}
bis(2-Chloroethyl)ether	2/31	2/41	0.43	0.43	1.5×10^{-9}	2.7×10^{-6}
BACKGROUND						
Antimony	6/23	7/30	5.4	4.2	$1.\times 9\ 10^{-8}$	--[f]
Arsenic	27/27	34/34	10	8.9	3.6×10^{-8}	--[f]
Benzo(a)pyrene	13/31	20/41	1.6	1.3	5.8×10^{-9}	--[f]
Manganese	25/25	26/26	245	254	8.7×10^{-7}	--[f]

a. Lesser of the 95th percent upper confidence limit (UCL) of the mean concentration and the maximum detected concentration in surface soil samples.

b. Lesser of the 95th percent UCL of the mean concentration and the maximum detected concentration in combined surface and subsurface samples.

Table 6-6
Potential Upper-Bound Exposure Point Concentrations for Chemicals of Potential Concern and Background Chemicals

c. Modeled from soil concentrations. Includes fugitive dust emissions predicted using surface soil and gaseous emissions using combined surface and subsurface soil. Refer to Section 5.3.1 of text and Appendix D.

d. "ND"-- Not detected in this medium.

e. "NA"-- Not applicable because this compound was not detected in Production Area soil, from which airborne emissions are modeled.

f. River water concentrations were not modeled for background compounds.

Table 6-7
Toxicity Summary for Chemicals of Potential Concern and Background Chemicals

Chemical	RfD[a] Oral (mg/kg-day)	RfD_i[b] Inhalation (mg/kg-day)	Target Organ[c]	Cancer WOE[d]	CSF_o[e] Oral (/mg/kg-day)	CSF_i[f] Inhalation (/mg/kg-day)	Tumor Site(s)[g]
COPCs							
Aldrin	3×10^{-5}	(see RfD)[h]	Liver	B2	1.7×10^{1}	1.7×10^{1}	Liver carcinoma
Beryllium	5×10^{-3}	(see RfD)[h]	(None)	B2	4.3	8.4 [i]	Lung cancer, osteosarcomas
gamma-Chlordane	6×10^{-5}	(see RfD)[h]	Liver	B2	1.3	1.3	Liver (hepatocellular carcinomas)
Chlorobenzene	2×10^{-2}	5.71×10^{-3} [j]	Liver	D			
bis(2-Chloroethyl)ether				B2	1.1	(See CSF_o)[k]	Liver (hepatocellular carcinomas)
Dieldrin	5×10^{-5}	(see RfD)[h]	Liver	B2	1.6×10^{1}	1.6×10^{1}	Liver carcinoma
bis(2-Ethylhexyl)phthalate	2×10^{-2}	(see RfD)[h]	Liver	B2	1.4×10^{-2}	(See CSF_o)[k]	Liver (hepatocellular carcinomas)
2-Nitroaniline	(see RfD_i)[l]	5.71×10^{-5} [m]	Blood				
PCB 1248	8×10^{-5} [n]	(see RfD)[h]	Developing offspring				
PCB 1254	2×10^{-5}	(see RfD)[h]	Decreased antibody response eyes; nail beds				
PCB 1260				B2	7.7	(see CSF_o) [k]	Liver (hepatocellular carcinoma; neoplastic liver nodules)
2,3,7,8-TCDF[o]				B2[o]	1.56×10^{4} [o]	(see CSF_o) [k]	Liver, respiratory [o]
Tinuvin 327	2.5×10^{-3} [p]		Liver, kidney [p]				
Toluene	2×10^{-1}	1.14×10^{-1} [q]	Ingestion: liver, kidney Inhalation: nervous system				

Table 6-7
Toxicity Summary for Chemicals of Potential Concern and Background Chemicals

Chemical	RfD[a] Oral (mg/kg-day)	RfD_i[b] Inhalation (mg/kg-day)	Target Organ[c]	Cancer WOE[d]	CSF_o[e] Oral (/mg/kg-day)	CSF_i[f] Inhalation (/mg/kg-day)	Tumor Site(s)[g]
Vinyl chloride				A	1.9[j]	3.0×10^{-1}[j]	Liver and lung tumors
BACKGROUND							
Arsenic	3×10^{-4}	(see RfD)[h]	Skin, blood vessels	A	1.75	1.51×10^{1}	Lungs
Benz(a)pyrene				B2	7.3	(see CSF_o)[k]	Oral: Upper gastrointestinal Dermal: Skin Inhalation: Upper respiratory
Beryllium	5×10^{-3}	(see RfD)[h]	Heart, kidney, liver, spleen	B2	4.3	8.4	Lungs, Osteosarcomas
Chromium[r]	5×10^{-3}	(see RfD)[h]	None observed	A	Not reported	4.2×10^{1}	
Dibenz(a,h)anthracene				B2	7.3[s]	(see CSF_o)[k]	Lungs; mammae; skin; subcutaneous injection sites
Manganese[t]	1.4×10^{-1}	1.4×10^{-5}[u]	Central nervous system, muscle				
Vanadium	7×10^{-3}[j]	(See RfD)[h]	Not reported[h]				

a. Chronic reference dose, oral route. Source: Integrated Risk Information System database (IRIS), unless otherwise noted.

b. Chronic reference dose, inhalation exposure route. Calculated from reference concentrations (RfCs).

c. Source: Same as for the RfD value(s).

d. USEPA weight-of-evidence (WOE) classification system regarding carcinogenic effects. Source: IRIS, unless otherwise noted.

e. Cancer slope factor, oral exposure route. Source: IRIS, unless otherwise noted.

f. Cancer slope factor, inhalation route. Source: IRIS, unless otherwise noted.

g. Source: Same as for the CSF value.

Table 6-7
Toxicity Summary for Chemicals of Potential Concern and Background Chemicals

h. No RfD_i available in IRIS or *Health Effects Assessment Summary Tables* (HEAST); RfD value was substituted in the PHRA.

i. Value was estimated from the inhalation unit risk (UR_i) value of 2.4×10^{-3} $(ug/m^3)^{-1}$. Source of UR_i: IRIS.

j. Source: HEAST.

k. No CSF_i available in IRIS or HEAST; CSF_o was substituted in the PHERE.

l. No RfD available in IRIS or HEAST; RfD_i value was substituted in the PHERE.

m. RfC value of 2×10^{-4} (mg/m^3) was used to calculate the RfD_i; Source of RfC: HEAST.

n. No toxicity data available in IRIS or the HEAST (USEPA, 1994). Values were derived from a rhesus monkey toxicity study (Allen et al., 1979). The monkeys were given a dose equivalent to 8×10^{-3} mg/kg-day for approximately 1.5 years. This dose was divided by an uncertainty factor of 100. This includes a factor of 10 to account for human variability and a factor of 10 to extrapolate from a lowest-observed-adverse-effects level to a no-observed-adverse-effects level. A provisional PCB 1248 RfD of 1×10^{-3} mg/kg-day was estimated for immunologic effects, the critical effect of PCB 1254. Refer to Section 6.2 for discussion of the immunologic effects RfD for PCB 1248 and potential additive toxicity of PCB 1248 and PCB 1254.

o. Information on 2,3,7,8-tetrachlorodibenzofuran (2,3,7,8-TCDF) is from listing of 2,3,7,8-tetrachlorodibenzodioxin (TCDD). The CSFs for TCDD ($1.5 \times 10^{+5}$) $(mg/kg\text{-}day)^{-1}$ have been multiplied by a toxicity equivalency factor (TEF) of 0.1 to derive the CSF values for 2,3,7,8-TCDF. Source of TEF: USEPA, 1989b.

p. Derived from toxicity data provided by Ciba-Geigy.

q. Derived from the RfC of 4×10^{-1} mg/m^3. Source of RfC: IRIS.

r. Toxicity values are for Chromium VI.

s. Based on the CSF of benzo(a)pyrene using a toxicity equivalence factor of 1. Source: USEPA, 1993.

t. Value for manganese in food. Source: IRIS.

u. RfC value of 5×10^{-5} mg/m^3 was used to calculate the RfD_i.

Table 6-8
Risk Summary for Production Area
On-Site Worker Scenario

Noncancer Risks

CHEMICAL	HAZARD QUOTIENT			HAZARD INDEX
	Ingestion	Dermal	Inhalation	
PCB 1248 [a]	0.25	0.30	0.0069	0.55
PCB 1254	0.16	0.19	0.0012	0.35
gamma-Chlordane	0.00034	0.00080	0.0000029	0.0011
2-Nitroaniline	0.0024	0.0054	0.0015	0.0094
Chlorobenzene	0.0000022	0.0000097	0.000030	0.000042
Toluene	0.00000056	0.0000022	0.00050	0.00050
TOTAL HAZARD INDEX [b]				0.9

Cancer Risks

CHEMICAL	CANCER RISK			
	Ingestion	Dermal	Inhalation	Combined Routes
PCB 1260	2.6×10^{-6}	3.2×10^{-6}	1.4×10^{-8}	5.8×10^{-6}
gamma-Chlordane	9.5×10^{-9}	2.2×10^{-8}	8.1×10^{-11}	3.2×10^{-8}
Vinyl Chloride [c]	0	0	0	0
Total PCBs [d]	6.2×10^{-5}	7.5×10^{-5}	1.6×10^{-6}	1.4×10^{-4}
TOTAL LIFETIME INCREMENTAL CANCER RISK[e]				1×10^{-4}

a. Noncancer risks based on developmental effects.

b Assumes additivity for the effects of all COPCs . The THI for combined immunologic effects of PCB 1248 and PCB 1254 and PCBis estimated as 0.4.

c. Vinyl chloride was not detected in Production Area soils. It was selected as a COPC based on its detection in Production Area groundwater.

d. In accordance with USEPA Region I policy, risk of total PCBs was estimated assuming that all PCBs have the same cancer potency as PCB 1260. This policy contradicts toxicological data which indicate that PCB 1248 and PCB 1254 are noncarcinogenic. The total PCBs data set was created from the combined concentrations fo PCB 1248, PCB 1254, and PCB 1260 in surface soil (refer to Section 6.4.2.3.1.)

Table 6-9
Risk Summary for Production Area
General Worker Scenario

Noncancer Risks

CHEMICAL	HAZARD QUOTIENT			HAZARD INDEX
	Ingestion	Dermal	Inhalation	
PCB 1248 [a]	0.097	0.35	0.0041	0.45
PCB 1254	0.061	0.22	0.00072	0.28
gamma-Chlordane	0.00013	0.00094	0.0000017	0.0011
2-Nitroaniline	0.00096	0.0064	0.00087	0.0082
Chlorobenzene	0.00000086	0.000012	0.000018	0.000030
Toluene	0.00000022	0.0000026	0.00029	0.00029
TOTAL HAZARD INDEX [b]				0.8

Cancer Risks

CHEMICAL	CANCER RISK			
	Ingestion	Dermal	Inhalation	Combined Routes
PCB 1260	1.0×10^{-6}	3.7×10^{-6}	8.2×10^{-9}	4.7×10^{-6}
gamma-Chlordane	3.7×10^{-9}	2.6×10^{-8}	4.8×10^{-11}	3.0×10^{-8}
Vinyl Chloride [c]	0	0	0	0
Total PCBs [d]	2.5×10^{-5}	8.8×10^{-5}	9.4×10^{-7}	1.1×10^{-4}
TOTAL LIFETIME INCREMENTAL CANCER RISK[e]				1×10^{-4}

a. Noncancer risks based on developmental effects.

b. Assumes additivity for the effects of all COPCs . The THI for combined immunologic effects of PCB 1248 and PCB 1254 is estimated as 0.3.

c. Vinyl chloride was not detected in Production Area soils. It was selected as a COPC based on its detection in Production Area groundwater.

d. In accordance with USEPA Region I policy, risk of total PCBs was estimated assuming that all PCBs have the same cancer potency as PCB 1260. This policy contradicts toxicological data which indicate that PCB 1248 and PCB 1254 are noncarcinogenic. The total PCBs data set was created from the combined concentrations fo PCB 1248, PCB 1254, and PCB 1260 in surface soil (refer to Section 6.4.2.3.1.)

Table 6-10
Risk Summary for Production Area
Canoeist Scenario

Noncancer Risks

CHEMICAL	HAZARD QUOTIENT		HAZARD INDEX
	Ingestion	Dermal	
PCB 1248[a]	0.00000015	0.00071	0.00071
PCB 1254	0.00000011	0.00053	0.00053
gamma-Chlordane	0.0000000034	0.0000020	0.0000020
2-Nitroaniline	0.00013	0.00039	0.00052
Chlorobenzene	0.000000091	0.0000056	0.0000056
Toluene	0.000000077	0.0000043	0.0000044
TOTAL HAZARD INDEX[b]			0.0006

Cancer Risks

CHEMICAL	CANCER RISK		
	Ingestion	Dermal	Combined Routes
PCB 1260	6.9×10^{-14}	3.3×10^{-10}	3.3×10^{-10}
gamma-Chlordane	1.2×10^{-13}	6.6×10^{-11}	6.6×10^{-11}
Vinyl Chloride	3.4×10^{-11}	3.0×10^{-10}	3.3×10^{-10}
Total PCBs[c]	4.6×10^{-11}	2.2×10^{-7}	2.2×10^{-7}
TOTAL LIFETIME INCREMENTAL CANCER RISK[d]			2×10^{-7}

a. Noncancer risks based on developmental effects.

b. Assumes additivity for the effects of all COPCs. The THI for combined immunologic effects of PCB 1248 and PCB 1254 is estimated as 0.0006.

c. Vinyl chloride was not detected in Production Area soils. It was selected as a COPC based on its detection in Production Area groundwater.

d. In accordance with USEPA Region I policy, risk of total PCBs was estimated assuming that all PCBs have the same cancer potency as PCB 1260. This policy contradicts toxicological data which indicate that PCB 1248 and PCB 1254 are noncarcinogenic. The total PCBs data set was created from the combined concentrations of PCB 1248, PCB 1254, and PCB 1260 in surface soil (refer to Section 6.4.2.3.1.

Table 6-11
Risk Summary for Waste Water Treatment Area
On-Site Resident Scenario

Noncancer Risks

CHEMICAL	HAZARD QUOTIENT			HAZARD INDEX
	Ingestion	Dermal	Inhalation	
gamma-Chlordane	0.091	0.19	0.00047	0.28
PCB 1254	0.018	0.019	0.000087	0.037
Tinuvin 327	0.0075	0.016	0.0000058	0.023
Dieldrin	0.0058	0.012	0.000034	0.018
bis(2-Ethylhexyl)phthalate	0.00018	0.00037	0.00000019	0.00055
TOTAL HAZARD INDEX[a]				0.4

Cancer Risks

CHEMICAL	CANCER RISK			
	Ingestion	Dermal	Inhalation	Combined Routes
2,3,7,8 TCDF	7.0×10^{-6}	4.4×10^{-6}	9.1×10^{-8}	1.2×10^{-5}
gamma-Chlordane	3.0×10^{-6}	6.3×10^{-6}	1.6×10^{-8}	9.3×10^{-6}
Dieldrin	2.0×10^{-6}	4.1×10^{-6}	1.2×10^{-8}	6.1×10^{-6}
bis(2-Ethylhexyl)phthalate	2.1×10^{-8}	4.5×10^{-8}	2.3×10^{-11}	6.6×10^{-8}
Total PCBs[b]	1.2×10^{-6}	1.3×10^{-6}	5.8×10^{-9}	2.4×10^{-6}
TOTAL LIFETIME INCREMENTAL CANCER RISK				3×10^{-5}

a. Assumes additivity for the effects of all COPCs.

b. In accordance with USEPA Region I policy, risk of total PCBs was estimated assuming that all PCBs have the same cancer potency as PCB 1260. This policy is not consistent with toxicological data which indicate that PCB 1254 is noncarcinogenic. PCB 1254 is the only PCB detected in Waste Water Treatment Area soil or groundwater.

Table 6-12
Risk Summary for Waste Water Treatment Area
Canoeist Scenario

Noncancer Risks

CHEMICAL	HAZARD QUOTIENT		HAZARD INDEX
	Ingestion	Dermal	
gamma-Chlordane	0.0000000022	0.0000013	0.0000013
PCB 1254	0.00000000022	0.0000010	0.0000010
Tinuvin 327	0.00000000031	0.0000026	0.0000026
Dieldrin	0.0000000029	0.00000041	0.00000041
bis(2-Ethylhexyl)phthalate	0.00000000068	0.0000000097	0.000000010
TOTAL HAZARD INDEX[a]			0.000005

Cancer Risks

CHEMICAL	CANCER RISK		
	Ingestion	Dermal	Combined Routes
2,3,7,8 TCDF[b]	8.0×10^{-14}	6.8×10^{-10}	6.8×10^{-10}
gamma-Chlordane	7.5×10^{-14}	4.4×10^{-11}	4.4×10^{-11}
Dieldrin	9.8×10^{-13}	1.4×10^{-10}	1.4×10^{-10}
bis(2-Ethylhexyl)phthalate	8.1×10^{-14}	1.2×10^{-12}	1.3×10^{-12}
Total PCBs[c]	1.5×10^{-14}	6.9×10^{-11}	6.9×10^{-11}
TOTAL LIFETIME INCREMENTAL CANCER RISK			9×10^{-10}

a. Assumes additivity for the effect of all COPCs.

b. The transport of 2,3,7,8-TCDF in soil, groundwater, and surface water could not be modeled. Refer to Appendix E.

c. In accordance with USEPA Region I policy, risk of total PCBs was estimated assuming that all PCBs have the same cancer potency as PCB 1260. This policy is not consistent with toxicological data which indicate that PCB 1254 is noncarcinogenic. PCB 1254 is the only PCB detected in Waste Water Treatment Area soil.

Table 6-13
Risk Summary for Warwick Area
On-Site Resident Scenario

Noncancer Risks

CHEMICAL	HAZARD QUOTIENT			HAZARD INDEX
	Ingestion	Dermal	Inhalation	
PCB 1248 [a]	0.32	0.34	0.0035	0.66[a]
PCB 1254	0.44	0.47	0.0013	0.91
2-Nitroaniline	0.21	0.41	0.012	0.63
Chlorobenzene	0.000057	0.000022	0.013	0.013
Aldrin	0.012	0.025	0.000044	0.037
Beryllium	0.00028	0.0049	0.00000010	0.0052
Dieldrin	0.0054	0.011	0.000026	0.017
TOTAL HAZARD INDEX[b]				1[b]

Cancer Risks

CHEMICAL	CANCER RISK			
	Ingestion	Dermal	Inhalation	Combined Routes
Aldrin	2.6×10^{-6}	5.4×10^{-6}	9.7×10^{-9}	8.0×10^{-6}
Beryllium	2.6×10^{-6}	4.5×10^{-5}	1.9×10^{-9}	4.8×10^{-5}
Dieldrin	1.9×10^{-6}	3.9×10^{-6}	8.9×10^{-9}	5.7×10^{-6}
bis(2-Chloroethyl)ether	3.5×10^{-7}	7.1×10^{-7}	1.3×10^{-10}	1.1×10^{-6}
Total PCBs[c]	1.0×10^{-4}	1.1×10^{-4}	1.0×10^{-6}	2.1×10^{-4}
TOTAL LIFETIME INCREMENTAL CANCER RISK				3×10^{-4}

a. Noncancer risks for PCB 1248 based on developmental effects. Hazard Index based on immunologic effects is 0.06, which is additive with PCB 1254.

b. Assumes additivity of the critical effects for chemicals with similar target organs. The target organ-specific THI for combined immunologic effects of PCB 1248 and PCB 1254 results in the highest target organ-specific THI, i.e., 1.

c. In accordance with USEPA Region I policy, risk of total PCBs was estimated assuming that all PCBs have the same cancer potency as PCB 1260. This policy is not consistent with toxicological data which indicate that PCB 1248 and PCB 1254 are noncarcinogenic. PCB 1248 and PCB 1254 are the only PCBs detected in Warwick Area soil.

Table 6-14
Risk Summary for Warwick Area
Canoeist Scenario

Noncancer Risks

CHEMICAL	HAZARD QUOTIENT		HAZARD INDEX
	Ingestion	Dermal	
PCB 1248[a]	0.0000000042	0.000020	0.000020
PCB 1254	0.0000000076	0.000036	0.000036
2-Nitroaniline	0.00046	0.0014	0.0018
Chlorobenzene	0.000000048	0.0000020	0.00000020
Aldrin	0.00000020	0.0000027	0.0000029
Beryllium	0.0000000015	0.0000014	0.0000014
Dieldrin	0.0000000014	0.00000020	0.00000020
TOTAL HAZARD INDEX[b]			0.002

Cancer Risks

CHEMICAL	CANCER RISK		
	Ingestion	Dermal	Combined Routes
Aldrin	4.4×10^{-11}	5.8×10^{-10}	6.2×10^{-10}
Beryllium	1.4×10^{-11}	1.3×10^{-8}	1.3×10^{-8}
Dieldrin	5.0×10^{-13}	7.0×10^{-11}	7.0×10^{-11}
bis(2-Chloroethyl)ether	2.0×10^{-12}	7.6×10^{-12}	9.6×10^{-12}
Total PCBs[c]	1.6×10^{-12}	7.6×10^{-9}	7.6×10^{-9}
TOTAL LIFETIME INCREMENTAL CANCER RISK			2×10^{-8}

a. Noncancer risks based on developmental effects.

b. Assumes additivity for the effects of all COPCs. The THI for the combined immunologic effects of PCB 1248 and 1254 is estimated as 0.00004

c. In accordance with USEPA Region I policy, risk of total PCBs was estimated assuming that all PCBs have the same cancer potency as PCB 1260. This policy is not consistent with toxicological data which indicate that PCB 1248 and PCB 1254 are noncarcinogenic. PCB 1248 and PCB 1254 are the only PCBs detected in Warwick Area soil or groundwater.

Table 6-15
Background Risk Summary for Production Area

On-Site Worker Scenario--Noncancer Risks

CHEMICAL	HAZARD QUOTIENT			HAZARD INDEX
	Ingestion	Dermal	Inhalation	
Arsenic	0.0078	0.00016	0.0000068	0.0080
Chromium	0.00044	0.00018	0.00000038	0.00061
Vanadium	0.00047	0.000094	0.00000041	0.00056
TOTAL HAZARD INDEX[a]				0.009

On-Site Worker Scenario--Cancer Risks

CHEMICAL	CANCER RISK			
	Ingestion	Dermal	Inhalation	Combined Routes
Arsenic	1.5×10^{-6}	3.0×10^{-8}	1.1×10^{-8}	1.5×10^{-6}
Benzo(a)pyrene	6.9×10^{-7}	1.4×10^{-6}	6.1×10^{-10}	2.1×10^{-6}
Chromium[b]	--	--	2.9×10^{-8}	2.9×10^{-8}
Dibenz(a,h) anthracene	2.8×10^{-7}	5.6×10^{-7}	2.4×10^{-10}	8.3×10^{-7}
TOTAL LIFETIME INCREMENTAL CANCER RISK				4×10^{-6}

General Worker Scenario--Noncancer Risks

CHEMICAL	HAZARD QUOTIENT			HAZARD INDEX
	Ingestion	Dermal	Inhalation	
Arsenic	0.00031	0.00019	0.0000040	0.0033
Chromium	0.00017	0.00021	0.00000022	0.00038
Vanadium	0.00018	0.00011	0.00000024	0.00030
TOTAL HAZARD INDEX[a]				0.004

Table 6-15
Background Risk Summary for Production Area

General Worker Scenario–Cancer Risks

CHEMICAL	CANCER RISK			
	Ingestion	Dermal	Inhalation	Combined Routes
Arsenic	5.8×10^{-7}	3.5×10^{-8}	6.5×10^{-9}	6.2×10^{-7}
Benzo(a)pyrene	2.7×10^{-7}	1.6×10^{-6}	3.6×10^{-10}	1.9×10^{-6}
Chromium[b]	--	--	1.7×10^{-6}	1.7×10^{-6}
Dibenz(a,h) anthracene	1.1×10^{-7}	6.5×10^{-7}	1.4×10^{-10}	7.6×10^{-7}
TOTAL LIFETIME INCREMENTAL CANCER RISK				3×10^{-6}

a. Assumes additivity for the effects of all background compounds.

b. Chromium is considered a carcinogen by the inhalation pathway only.

Table 6-16
Background Risk Summary for Waste Water Treatment Area
On-Site Resident Scenario

Noncancer Risks

CHEMICAL	HAZARD QUOTIENT			HAZARD INDEX
	Ingestion	Dermal	Inhalation	
Arsenic	0.044	0.00079	0.000034	0.045
Beryllium	0.00018	0.0031	0.00000014	0.0033
Chromium	0.0041	0.0014	0.0000032	0.0055
Manganese	0.0033	0.00059	0.026	0.030
Vanadium	0.0029	0.00051	0.0000023	0.0034
TOTAL HAZARD INDEX [a]				0.09

Cancer Risks

CHEMICAL	CANCER RISK			
	Ingestion	Dermal	Inhalation	Combined Routes
Arsenic	9.8×10^{-6}	1.8×10^{-8}	6.6×10^{-8}	1.0×10^{-5}
benzo(a)Pyrene	8.0×10^{-6}	1.4×10^{-5}	6.3×10^{-9}	2.2×10^{-5}
Beryllium	1.6×10^{-6}	2.9×10^{-5}	2.5×10^{-9}	3.0×10^{-5}
Chromium[b]	--	--	2.9×10^{-7}	2.9×10^{-7}
Dibenz(a,h)anthracene	1.6×10^{-5}	2.8×10^{-5}	1.2×10^{-8}	4.4×10^{-5}
TOTAL LIFETIME INCREMENTAL CANCER RISK				1×10^{-4}

a. Assumes additivity for the critical effects of all background compounds.

Table 6-17
Background Risk Summary for Warwick Area
On-Site Resident Scenario

Noncancer Risks

CHEMICAL	HAZARD QUOTIENT			HAZARD INDEX
	Ingestion	Dermal	Inhalation	
Antimony	0.023	0.0041	0.0000085	0.027
Arsenic	0.057	0.0010	0.000021	0.058
Manganese	0.0030	0.00053	0.0011	0.015
TOTAL HAZARD INDEX [a]				0.1

Cancer Risks

CHEMICAL	CANCER RISK			
	Ingestion	Dermal	Inhalation	Combined Routes
Arsenic	1.3×10^{-5}	2.3×10^{-7}	4.1×10^{-8}	1.3×10^{-5}
Benzo(a)pyrene	8.5×10^{-6}	1.5×10^{-5}	3.2×10^{-9}	2.4×10^{-5}
TOTAL LIFETIME INCREMENTAL CANCER RISK				4×10^{-5}

a. Assumes additivity for the critical effects of all background compounds.

Table 6-18
Chemicals Of Potential Concern

PRODUCTION AREA	WARWICK AREA	WASTEWATER TREATMENT AREA
INORGANICS	**INORGANICS**	**INORGANICS**
BERYLLIUM	ANTIMONY	BARIUM
CADMIUM	BARIUM	CADMIUM
COBALT	BERYLLIUM	COBALT
COPPER	CADMIUM	COPPER
LEAD	COBALT	LEAD
MERCURY	CHROMIUM	MERCURY
NICKEL	COPPER	NICKEL
THALLIUM	LEAD	SILVER
TIN	MERCURY	THALLIUM
ZINC	NICKEL	ZINC
CYANIDE	TIN	CYANIDE
	VANADIUM	
	ZINC	
	CYANIDE	
ORGANICS	**ORGANICS**	**ORGANICS**
2-METHYLNAPHTHALENE	1,1-BIPHENYL	2-METHYLNAPHTHALENE
2-NITROANILINE	1,4-DICHLOROBENZENE	2-NITROANILINE
3&4-METHYLPHENOL	2-BUTANONE	2,3,7,8-TCDF
4-CHLOROANILINE	2-METHYLNAPHTHALENE	2,4,5-T
ACENAPHTHENE	2-NITROANILINE	2,4-DICHLOROPHENOL
ACENAPHTHYLENE	2,4,5-TP (SILVEX)	3&4-METHYLPHENOL
ANTHRACENE	3&4-METHYLPHENOL	4-CHLOROANILINE
BENZO(A)ANTHRACENE	4-CHLOROANILINE	4-CHLOROPHENYL-PHENYLETHER
BENZO(B)FLUORANTHENE	4,4'-DDD	4-METHYLPHENOL
BENZO(G,H,I)PERYLENE	4,4'-DDE	4,4'-DDD
BENZO(K)FLUORANTHENE	4,4'-DDT	4,4'-DDE
BIS(2-ETHYLHEXYL)PHTHALATE	ALDRIN	4,4'-DDT
BUTYLBENZYLPHTHALATE	ALPHA-BHC	ACENAPHTHENE

Table 6-18
Chemicals Of Potential Concern

PRODUCTION AREA	WARWICK AREA	WASTEWATER TREATMENT AREA
CHLOROBENZENE	ALPHA-CHLORDANE	ACENAPHTHYLENE
CHRYSENE	ACENAPHTHENE	ACETONE
DI-N-BUTYLPHTHALATE	ACENAPHTHYLENE	ACETOPHENONE
DIBENZOFURAN	ANTHRACENE	ALPHA-BHC
DINOSEB	BENZO(A)ANTHRACENE	ANILINE
ETHYLBENZENE	BENZO(B)FLUORANTHENE	ANTHRACENE
FLUORENE	BENZO(G,H,I)PERYLENE	BIS(2-ETHYLHEXYL)PHTHALATE
FLUORANTHENE	BENZO(K)FLUORANTHENE	BUTYLBENZYLPHTHALATE
GAMMA-CHLORDANE	BETA-BHC	CHLOROBENZENE
INDENO(1,2,3-CD)PYRENE	BIS(2-CHLOROETHYL)ETHER	DCDF
IRGASAN DP-300	BIS(2-ETHYLHEXYL)PHTHALATE	DIBENZOFURAN
M&P-XYLENE	BUTYLBENZYLPHTHALATE	DIELDRIN
METHOXYCHLOR	CHLOROBENZENE	DIETHYLPHTHALATE
METHYLENE CHLORIDE	CHRYSENE	ENDRIN
NAPHTHALENE	DELTA-BHC	ENDRIN ALDEHYDE
NITROBENZENE	DIBENZ(A,H)ANTHRACENE	ETHYL PARATHION
O-XYLENE	DI-N-OCTYLPHTHALATE	ETHYLBENZENE
OCDD	DIBENZOFURAN	FAMPHUR
ORTHOPHOSPHATE	DIELDRIN	FLUORANTHENE
PCB-1248	DISULFOTON	FLUORENE
PCB-1254	ENDOSULFAN I	GAMMA-CHLORDANE
PCB-1260	ENDOSULFAN SULFATE	HEPTACHLOR
PHENANTHRENE	ENDRIN	IRGASAN DP-300
PYRENE	ENDRIN ALDEHYDE	M&P-XYLENE
TCDF	ETHYL PARATHION	METHYL PARATHION
TOLUENE	FLUORANTHENE	METHYLENE CHLORIDE
TRCDF	FLUORENE	NAPHTHALENE
TRICHLOROFLUOROMETHANE	GAMMA-BHC	O-XYLENE
	GAMMA-CHLORDANE	OCDD
	HEPTACHLOR EPOXIDE	ORTHOPHOSPHATE

Table 6-18
Chemicals Of Potential Concern

PRODUCTION AREA	WARWICK AREA	WASTEWATER TREATMENT AREA
	INDENO(1,2,3-CD)PYRENE	PHENANTHRENE
	ISODRIN	PHENOL
	M&P-XYLENE	PHORATE
	METHOXYCHLOR	PROPAZINE
	METHYLENE CHLORIDE	PYRENE
	NAPHTHALENE	SULFOTEPP
	NITROBENZENE	TCDF
	O-XYLENE	TINUVIN 327
	ORTHOPHOSPHATE	TOLUENE
	PCB-1248	TRCDF
	PCB-1254	
	PHENANTHRENE	
	PHENOL	
	PYRENE	
	SAFROLE	
	TETRACHLOROETHENE	
	TINUVIN 327	
	TOLUENE	
	TRICHLOROETHENE	

Table 6-19
Chemicals Of Potential Concern Seep Sediment And Surface Water
Waste Water Treatment Area

SEDIMENT	SURFACE WATER
INORGANICS	**INORGANICS**
BARIUM	
CADMIUM	BARIUM
COBALT	LEAD
COPPER	ZINC
LEAD	
NICKEL	
THALLIUM	
ZINC	
ORGANICS	**ORGANICS**
2-METHYLNAPHTHALENE	2-HEXANONE
2,3,7,8-TCDF	4,4'-DDE
4-CHLOROPHENYL-PHENYLETHER	ALDRIN
4,4'-DDD	KEPONE
4,4'-DDE	
4,4'-DDT	
ACENAPHTHENE	
ACETONE	
ALPHA-CHLORDANE	
ANTHRACENE	
BIS(2-ETHYLHEXYL)PHTHALATE	
BUTYLBENZYLPHTHALATE	
CHLOROBENZENE	
DCDF	
DIBENZOFURAN	
ENDRIN	
FLUORANTHENE	
GAMMA-CHLORDANE	
KEPONE	
M&P-XYLENE	
NAPHTHALENE	
OCDD	
PHENANTHRENE	
PYRENE	
TCDF	
TINUVIN 327	
TOLUENE	
TRCDF	

Table 6-20
Summary of Problem Formulation Results

Study Site	COPCs Present?	Receptors Available?	Complete Exposure Pathways?	Comments/ Recommendations
Production Area	yes	yes	limited	COPCs are present; poor habitat quality suggests that potential receptors are likely to be few in number; poor habitat and lack of forage/cover suggests infrequent site use (and hence exposure); site has potential to pose risk to receptors; interim remedial measures will greatly lower any potential risk.
Waste Water Treatment Area	yes	yes	yes	COPCs are present; majority of Area contains a variety of habitats (grassland, woodland, seeps, shrubs) that could harbor potential receptors; suitable habitat with good cover/forage suggests resident receptors with frequent use and exposure; site has potential to pose risk to receptors.
Warwick Area	yes	yes	yes	COPCs are present; revegetation in cleared areas and remaining woodlands offer habitat for potential receptors; suitable habitat with good cover/forage suggests residential receptors with frequent use and exposure; site has potential to pose risk to receptors; interim remedial measures will greatly lower any potential risk.

Table 6-21
Summary of Model Parameters

Parameter	Insect	Deer Mouse	Red-tailed Hawk	Raccoon	Great Blue Heron[d]
dietary fraction (F_{xx})[a]	1.0, terrestrial plants	0.25, terrestrial insect 0.73, terrestrial plants 0.02, incidentally ingested soil	0.75, deer mice 0.25, birds	0.51, terrestrial plant 0.10, terrestrial insect 0.30, deer mouse 0.09, incidentally ingested soil	1.0, aquatic species
area use factor (Θ_{xx})	1.0, assumed to be permanent resident of a given Area	Production:1.0 Warwick: 0.035 Wastewater: 1.0	0.1, any Area is assumed to comprise only 10% of total foraging area	0.01, any Area is assumed to comprise only 1% of total foraging area	0.001, Waste Water Treatment Area is assumed to comprise only 0.1% of total foraging area
seasonality factor (Ψ_{xx})	0.58, assumed to be actively feeding in each Area from April to September	Production: 0.58 assumed to be actively feeding mid-June to mid-December (due to lack of cover vegetation). Waste Water Treatment Area: 1.0 Warwick Area: 1.0 (USEPA, 1993)	0.75, assumed to be actively feeding in each Area from March to October (USEPA, 1993b)	0.75, assumed to be actively feeding in each Area March to October (USEPA, 1993b)	
mean body weight (W_{xx})	0.000135 kg[b]	0.0215 kg[b]	1.0 kg[c]	7.6 kg[c]	3 kg[c]
food intake rate (R_{xx})[d]	0.0000184 kg/d	0.0029 kg/d	0.0582 kg/d	0.3639 kg/d	0.119 kg/d

a. Estimated using data from USEPA (1993b) and MacIntosh et al. (1992)
b. From MacIntosh et al. (1992)
c. From USEPA, 1993
d. Waste Water Treatment Area only

Table 6-22
Estimated Receptor Exposures from Surface Soil
Production Area

Chemical Name	Selected Concentration	Plant Tissue Concentration	Insect Tissue Concentration	Deer Mouse Concentration	Deer Mouse Daily Dose	Red-Tailed Hawk Daily Dose	Raccoon Daily Dose
INORGANICS							
BERYLLIUM	4.54E-01	6.80E-04	4.83E-05	6.75E-04	7.50E-04	2.21E-06	1.48E-05
CADMIUM	8.74E-01	1.31E-01	6.21E-04	5.32E-04	8.87E-03	1.74E-06	5.23E-05
COBALT	3.44E+00	2.41E-02	1.71E-03	6.11E-03	6.79E-03	2.00E-05	1.16E-04
COPPER[a]	3.05E+01	7.63E+00	3.01E-01	2.45E-01	4.90E-01	8.01E-04	2.42E-03
LEAD	7.95E+01	7.15E-01	5.64E-03	1.65E-02	1.65E-01	5.41E-05	2.70E-03
MERCURY	6.11E-01	1.22E-01	1.44E-03	1.19E-03	7.96E-03	3.90E-06	4.22E-05
NICKEL[a]	1.16E+01	6.97E-01	2.75E-03	2.90E-03	5.81E-02	9.50E-06	5.03E-04
THALLIUM	2.14E-01	8.57E-05	6.09E-06	3.07E-04	3.41E-04	1.00E-06	6.97E-06
TIN	6.60E+00	3.96E-02	2.81E-03	1.14E-02	1.26E-02	3.72E-05	2.22E-04
ZINC[a]	3.68E+02	3.31E+02	1.31E+01	9.87E+00	1.97E+01	3.23E-02	7.40E-02
CYANIDE	1.98E+00	0.00E+00	0.00E+00	0.00E+00	3.10E-03	0.00E+00	6.40E-05
ORGANICS							
2-METHYLNAPHTHALENE	3.80E-01	8.64E-02	6.82E-03	5.10E-03	5.66E-03	1.67E-05	2.89E-05
2-NITROANILINE	8.90E-01	3.18E+00	2.26E-01	1.69E-01	1.88E-01	5.52E-04	6.37E-04
3&4-METHYLPHENOL	2.52E-01	7.10E-01	5.04E-02	3.77E-02	4.19E-02	1.23E-04	1.44E-04
4-CHLOROANILINE	6.40E-01	2.17E+00	1.54E-01	1.15E-01	1.28E-01	3.77E-04	4.36E-04
ACENAPHTHENE	2.10E-01	3.16E-02	2.49E-03	1.97E-03	2.18E-03	6.43E-06	1.29E-05
ACENAPHTHYLENE	1.80E-01	3.78E-02	2.98E-03	2.25E-03	2.50E-03	7.36E-06	1.31E-05
ANTHRACENE	1.29E+00	1.43E-01	1.13E-02	9.39E-03	1.04E-02	3.07E-05	6.94E-05
BENZO(A)ANTHRACENE	1.52E+00	3.40E-02	2.68E-03	3.93E-03	4.37E-03	1.29E-05	5.57E-05
BENZO(B)FLUORANTHENE	1.98E+00	1.22E-02	9.64E-04	3.43E-03	3.82E-03	1.12E-05	6.65E-05
BENZO(G,H,I)PERYLENE	1.81E+00	4.64E-03	3.66E-04	2.80E-03	3.11E-03	9.14E-06	5.96E-05
BENZO(K)FLUORANTHENE	1.95E+00	8.40E-03	6.63E-04	3.19E-03	3.54E-03	1.04E-05	6.49E-05
BIS(2-ETHYLHEXYL)PHTHALATE	1.49E+00	3.29E-02	2.34E-03	3.83E-03	4.25E-03	1.25E-05	5.45E-05
BUTYLBENZYLPHTHALATE	3.22E+00	3.26E-01	2.31E-02	2.17E-02	2.41E-02	7.09E-05	1.67E-04
CHLOROBENZENE	2.80E-01	2.48E-01	1.76E-02	1.34E-02	1.49E-02	4.39E-05	5.64E-05
CHRYSENE	1.62E+00	3.63E-02	2.86E-03	4.19E-03	4.66E-03	1.37E-05	5.94E-05
DI-N-BUTYLPHTHALATE	1.30E+00	2.92E-02	2.07E-03	3.37E-03	3.74E-03	1.10E-05	4.78E-05

Table 6-22
Estimated Receptor Exposures from Surface Soil
Production Area

Chemical Name	Selected Concentration	Plant Tissue Concentration	Insect Tissue Concentration	Deer Mouse Concentration	Deer Mouse Daily Dose	Red-Tailed Hawk Daily Dose	Raccoon Daily Dose
DIBENZOFURAN	1.30E-01	2.09E-02	1.49E-03	1.29E-03	1.43E-03	4.20E-06	8.22E-06
DINOSEB	8.70E-03	2.58E-03	1.83E-04	1.48E-04	1.65E-04	4.85E-07	7.76E-07
ETHYLBENZENE	3.41E+00	1.99E+00	1.42E-01	1.10E-01	1.22E-01	3.59E-04	4.92E-04
FLUORANTHENE	2.05E+00	6.61E-02	5.21E-03	6.38E-03	7.09E-03	2.09E-05	7.93E-05
FLUORENE	1.80E-01	2.67E-02	2.11E-03	1.67E-03	1.85E-03	5.45E-06	1.10E-05
GAMMA-CHLORDANE	1.32E-01	3.04E-03	2.16E-04	3.46E-04	3.85E-04	1.13E-06	4.86E-06
INDENO(1,2,3-CD)PYRENE	1.79E+00	2.59E-03	2.04E-04	2.66E-03	2.95E-03	8.69E-06	5.85E-05
IRGASAN DP-300	4.20E+00	data gap	data gap	data gap	data gap	data gap	data gap
M&P-XYLENE	2.70E+01	1.48E+01	1.05E+00	8.18E-01	9.09E-01	2.68E-03	3.71E-03
METHOXYCHLOR	5.55E-01	7.03E-02	4.99E-03	4.48E-03	4.98E-03	1.47E-05	3.15E-05
METHYLENE CHLORIDE	9.50E-03	6.52E-02	4.63E-03	3.45E-03	3.83E-03	1.13E-05	1.28E-05
NAPHTHALENE	6.80E-01	3.01E-01	2.37E-02	1.68E-02	1.87E-02	5.51E-05	7.97E-05
NITROBENZENE	1.40E-01	4.27E-01	3.03E-02	2.27E-02	2.52E-02	7.41E-05	8.61E-05
O-XYLENE	8.12E+00	6.20E+00	4.40E-01	3.38E-01	3.76E-01	1.11E-03	1.45E-03
OCDD	4.60E-04	3.71E-06	2.63E-07	8.44E-07	9.37E-07	2.76E-09	1.56E-08
ORTHOPHOSPHATE	8.13E+00	data gap	data gap	data gap	data gap	data gap	data gap
PCB-1248	1.27E+02	2.33E-02	1.65E-03	1.80E-01	2.00E-01	5.88E-04	4.11E-03
PCB-1254	2.03E+01	3.73E-03	2.64E-04	2.87E-02	3.19E-02	9.40E-05	6.58E-04
PCB-1260	6.10E+00	1.12E-03	7.96E-05	8.66E-03	9.62E-03	2.83E-05	1.98E-04
Total PCB's	1.45E+02	2.67E-02	1.89E-03	2.06E-01	2.29E-01	6.73E-04	4.71E-03
PHENANTHRENE	1.54E+00	1.57E-01	1.24E-02	1.05E-02	1.16E-02	3.43E-05	8.01E-05
PYRENE	2.30E+00	9.04E-02	7.13E-03	8.02E-03	8.91E-03	2.62E-05	9.20E-05
TCDF	1.77E-04	1.42E-06	1.01E-07	3.24E-07	3.60E-07	1.06E-09	6.01E-09
TOLUENE	7.14E-01	7.71E-01	5.47E-02	4.16E-02	4.62E-02	1.36E-04	1.71E-04
TRCDF	5.41E-01	4.36E-03	3.10E-04	9.93E-04	1.10E-03	3.25E-06	1.84E-05
TRICHLOROFLUOROMETHANE	3.30E-01	4.41E-01	3.13E-02	2.37E-02	2.63E-02	7.74E-05	9.50E-05

a- compound is log normally distributed. Mean concentration is the geometric mean.

Table 6-23

Estimated Receptor Exposure from Surface Soil[a]

Waste Water Treatment Area

Chemical Name	Selected Concentration (mg/kg)	Plant Tissue Concentration (mg/kg)	Insect Tissue Concentration (mg/kg)	Deer Mouse Concentration (mg/kg)	Deer Mouse Daily Dose (mg/kg)	Red-Tailed Hawk Daily Dose (mg/kg)	Raccoon Daily Dose (mg/kg)
INORGANICS							
BARIUM	3.52E+01	5.27E-01	4.16E-02	1.48E-02	1.48E-01	4.85E-05	1.24E-03
CADMIUM	3.86E-01	5.79E-02	4.57E-03	4.14E-04	6.90E-03	1.35E-06	2.33E-05
COBALT	3.81E+00	2.67E-02	2.10E-03	1.17E-02	1.30E-02	3.82E-05	1.29E-04
COPPER	4.53E+01	1.13E+01	8.94E-01	6.34E-01	1.27E+00	2.07E-03	3.64E-03
LEAD	5.36E+01	4.82E-01	3.80E-02	1.93E-02	1.93E-01	6.33E-05	1.82E-03
MERCURY	1.93E-01	3.85E-02	3.04E-03	6.63E-04	4.42E-03	2.17E-06	1.35E-05
NICKEL	8.55E+00	5.13E-01	4.04E-02	3.75E-03	7.49E-02	1.23E-05	3.72E-04
SILVER	1.19E+00	1.19E-01	9.38E-03	1.37E-02	1.52E-02	4.49E-05	6.20E-05
THALLIUM	2.76E-01	1.11E-04	8.72E-06	6.82E-04	7.58E-04	2.23E-06	9.02E-06
ZINC	3.59E+02	3.23E+02	2.55E+01	1.68E+01	3.37E+01	5.50E-02	7.35E-02
CYANIDE	1.14E+00	0.00E+00	0.00E+00	0.00E+00	3.07E-03	0.00E+00	3.68E-05
ORGANICS							
2-METHYLNAPHTHALENE	5.00E-01	1.14E-01	8.97E-03	1.16E-02	1.29E-02	3.78E-05	3.85E-05
2-NITROANILINE	7.30E-02	2.61E-01	1.85E-02	2.39E-02	2.65E-02	7.81E-05	5.34E-05
2,3,7,8-TCDF	4.58E-04	3.69E-06	2.62E-07	1.45E-06	1.61E-06	4.73E-09	1.56E-08
2,4,5-T	3.11E-02	1.87E-02	1.32E-03	1.77E-03	1.97E-03	5.79E-06	4.66E-06
2,4-DICHLOROPHENOL	8.39E-01	4.41E-01	3.13E-02	4.21E-02	4.68E-02	1.38E-04	1.14E-04
3&4-METHYLPHENOL	2.51E-01	7.17E-01	5.08E-02	6.57E-02	7.30E-02	2.15E-04	1.48E-04
4-CHLOROANILINE	1.71E+00	5.81E+00	4.12E-01	5.32E-01	5.91E-01	1.74E-03	1.19E-03
4-CHLOROPHENYL-PHENYLETHER	2.80E-01						
4-METHYLPHENOL	2.90E-01	8.61E-01	6.10E-02	7.89E-02	8.76E-02	2.58E-04	1.78E-04
4,4'-DDD	1.73E-01	2.57E-03	1.82E-04	6.53E-04	7.26E-04	2.14E-06	6.13E-06
4,4'-DDE	1.55E-01	3.09E-03	2.19E-04	6.58E-04	7.32E-04	2.15E-06	5.66E-06
4,4'-DDT	9.70E-03	1.31E-04	9.31E-06	3.55E-05	3.94E-05	1.16E-07	3.41E-07
ACENAPHTHENE	1.00E+00	1.51E-01	1.19E-02	1.61E-02	1.79E-02	5.28E-05	6.20E-05
ACENAPHTHYLENE	4.50E-02	9.45E-03	7.45E-04	9.70E-04	1.08E-03	3.17E-06	3.31E-06

Table 6-23

Estimated Receptor Exposure from Surface Soil[a]

Waste Water Treatment Area

Chemical Name	Selected Concentration (mg/kg)	Plant Tissue Concentration (mg/kg)	Insect Tissue Concentration (mg/kg)	Deer Mouse Concentration (mg/kg)	Deer Mouse Daily Dose (mg/kg)	Red-Tailed Hawk Daily Dose (mg/kg)	Raccoon Daily Dose (mg/kg)
ACETONE	1.34E-01	7.15E+00	5.07E-01	6.50E-01	7.22E-01	2.12E-03	1.40E-03
ACETOPHENONE	2.60E-02	1.08E-01	7.63E-03	9.84E-03	1.09E-02	3.22E-05	2.19E-05
ALPHA-BHC	2.10E-03	4.53E-04	3.21E-05	4.62E-05	5.14E-05	1.51E-07	1.57E-07
ANILINE	1.23E+00	1.43E+01	1.02E+00	1.30E+00	1.45E+00	4.27E-03	2.84E-03
ANTHRACENE	1.00E+00	1.11E-01	8.75E-03	1.25E-02	1.39E-02	4.10E-05	5.43E-05
BIS(2-ETHYLHEXYL)PHTHALATE	1.78E+00	3.95E-02	2.80E-03	7.91E-03	8.79E-03	2.59E-05	6.57E-05
BUTYLBENZYLPHTHALATE	1.50E-01	1.52E-02	1.07E-03	1.74E-03	1.93E-03	5.69E-06	7.84E-06
CHLOROBENZENE	2.62E+00	2.31E+00	1.64E-01	2.17E-01	2.41E-01	7.08E-04	5.37E-04
DCDF	2.02E+00	1.63E-02	1.16E-03	6.40E-03	7.11E-03	2.09E-05	6.91E-05
DIBENZOFURAN	7.03E-01	1.13E-01	8.03E-03	1.20E-02	1.33E-02	3.92E-05	4.50E-05
DIELDRIN	1.50E-01	5.52E-02	3.92E-03	5.38E-03	5.98E-03	1.76E-05	1.57E-05
DIETHYLPHTHALATE	7.36E-01	1.08E+00	7.65E-02	9.97E-02	1.11E-01	3.26E-04	2.35E-04
ENDRIN	7.00E-03	1.57E-04	1.11E-05	3.13E-05	3.48E-05	1.02E-07	2.59E-07
ENDRIN ALDEHYDE	2.09E-01	4.70E-03	3.33E-04	9.35E-04	1.04E-03	3.06E-06	7.73E-06
ETHYL PARATHION	5.40E-02	1.40E-02	9.95E-04	1.41E-03	1.56E-03	4.60E-06	4.50E-06
ETHYLBENZENE	4.41E-01	2.58E-01	1.83E-02	2.45E-02	2.72E-02	8.01E-05	6.48E-05
FAMPHUR	7.70E-02	1.42E-01	1.01E-02	1.31E-02	1.45E-02	4.27E-05	3.02E-05
FLUORANTHENE	1.56E+00	5.03E-02	3.97E-03	8.38E-03	9.31E-03	2.74E-05	6.08E-05
FLUORENE	5.10E-01	7.58E-02	5.98E-03	8.14E-03	9.04E-03	2.66E-05	3.14E-05
GAMMA-CHLORDANE	2.58E+00	5.95E-02	4.22E-03	1.17E-02	1.30E-02	3.81E-05	9.56E-05
HEPTACHLOR	7.79E-02	3.02E-03	2.14E-04	4.63E-04	5.15E-04	1.51E-06	3.13E-06
IRGASAN DP-300	8.61E+01						
M&P-XYLENE	1.65E+00	9.02E-01	6.40E-02	8.59E-02	9.55E-02	2.81E-04	2.30E-04
METHYL PARATHION	2.13E-02	6.50E-02	4.61E-03	5.95E-03	6.61E-03	1.95E-05	1.34E-05
METHYLENE CHLORIDE	1.10E-02	7.55E-02	5.36E-03	6.88E-03	7.65E-03	2.25E-05	1.51E-05
NAPHTHALENE	8.27E-01	3.66E-01	2.89E-02	3.53E-02	3.92E-02	1.16E-04	9.85E-05
O-XYLENE	6.35E-01	4.85E-01	3.44E-02	4.56E-02	5.06E-02	1.49E-04	1.15E-04

Table 6-23

Estimated Receptor Exposure from Surface Soil[a]
Waste Water Treatment Area

Chemical Name	Selected Concentration (mg/kg)	Plant Tissue Concentration (mg/kg)	Insect Tissue Concentration (mg/kg)	Deer Mouse Concentration (mg/kg)	Deer Mouse Daily Dose (mg/kg)	Red-Tailed Hawk Daily Dose (mg/kg)	Raccoon Daily Dose (mg/kg)
OCDD	3.00E-04	2.42E-06	1.71E-07	9.48E-07	1.05E-06	3.10E-09	1.02E-08
ORTHOPHOSPHATE	6.15E+01						
PHENANTHRENE	1.44E+00	1.47E-01	1.16E-02	1.69E-02	1.88E-02	5.52E-05	7.56E-05
PHENOL	7.54E-01	4.18E+00	2.97E-01	3.82E-01	4.24E-01	1.25E-03	8.42E-04
PHORATE	1.70E-02	1.35E-02	9.58E-04	1.27E-03	1.41E-03	4.15E-06	3.19E-06
PROPAZINE	9.10E+00	7.14E+00	5.06E-01	6.70E-01	7.44E-01	2.19E-03	1.69E-03
PYRENE	2.25E+00	8.82E-02	6.96E-03	1.35E-02	1.50E-02	4.41E-05	9.04E-05
SULFOTEPP	6.31E-02	1.49E-02	1.06E-03	1.51E-03	1.68E-03	4.94E-06	4.98E-06
TCDF	3.30E-03	2.66E-05	1.89E-06	1.04E-05	1.16E-05	3.42E-08	1.13E-07
TINUVIN 327	8.67E+00	1.14E-01	8.11E-03	3.15E-02	3.49E-02	1.03E-04	3.05E-04
TOLUENE	1.81E+00	1.96E+00	1.39E-01	1.82E-01	2.02E-01	5.95E-04	4.41E-04
TRCDF	4.31E+00	3.47E-02	2.46E-03	1.36E-02	1.51E-02	4.45E-05	1.47E-04

a. Includes results from sediment sampling in seep.

Table 6-24
Estimated Receptor Exposure From Seep Sediments
Waste Water Treatment Area

Chemical Name	Selected Concentration	Pore Water Concentration	Daily Dose Heron
INORGANICS			
BARIUM	3.54E+01	5.90E-01	
CADMIUM	5.70E-01	8.77E-02	1.10E-04
COBALT	4.47E+00	9.93E-02	
COPPER	2.62E+01	7.50E-01	1.04E-01
LEAD	5.29E+01	5.87E-02	1.03E-02
NICKEL	8.80E+00	5.87E-02	8.20E-04
THALLIUM	4.28E-01	2.85E-04	
ZINC	2.21E+02	5.53E+00	2.06E-01
ORGANICS			
2-METHYLNAPHTHALENE	2.80E-01	1.32E-02	5.05E-03
2,3,7,8-TCDF	5.00E-05	8.04E-09	7.29E-05
4-CHLOROPHENYL-PHENYLETHER	2.80E-01	8.03E-03	7.42E-03
4,4'-DDD	1.34E-02	6.09E-06	8.72E-03
4,4'-DDE	1.71E-02	1.28E-05	7.58E-03
4,4'-DDT	9.70E-03	3.77E-06	7.15E-03
ACETONE	1.90E-01	9.61E+01	2.62E-06
ALPHA-CHLORDANE	4.50E-03	2.65E-05	4.06E-04
ACENAPHTHENE	1.00E+00	2.34E-02	3.10E-02
ANTHRACENE	1.43E+00	1.99E-02	6.64E-02
BIS(2-ETHYLHEXYL)PHTHALATE	1.00E+00	9.03E-04	3.87E-01
BUTYLBENZYLPHTHALATE	1.50E-01	1.78E-03	7.87E-03
CHLOROBENZENE	1.05E-01	5.00E-02	3.19E-04
DCDF	2.45E+00	3.93E-04	3.57E+00
DIBENZOFURAN	5.60E-01	1.47E-02	1.59E-02
ENDRIN	7.00E-03	6.43E-06	2.65E-03
FLUORANTHENE	3.64E+00	6.17E-03	8.61E-01
GAMMA-CHLORDANE	1.31E-02	1.26E-05	4.80E-03
KEPONE	3.97E-02	1.26E-01	2.76E-05
NAPHTHALENE	8.20E-01	1.20E-01	6.17E-03
M&P-XYLENE	1.00E-02	2.10E-03	5.68E-05
OCDD	3.00E-04	4.83E-08	4.38E-04
PHENANTHRENE	3.32E+00	4.03E-02	1.71E-01
PYRENE	3.57E+00	8.49E-03	6.49E-01
TCDF	4.00E-04	6.44E-08	5.83E-04
TINUVIN 327	5.10E-01	1.90E-04	3.89E-01
TOLUENE	1.73E-01	1.15E-01	4.02E-04
TRCDF	5.09E+00	8.18E-04	7.42E+00

Table 6-25
Estimated Receptor Exposure From Seep Surface Water
Waste Water Treatment Area

Chemical Name	Selected Concentration	Daily Dose Water
INORGANICS		
BARIUM	6.69E+01	8.23E-03
LEAD	2.55E+01	3.14E-03
ZINC	6.35E+01	7.81E-03
ORGANICS		
2-HEXANONE	7.00E+00	8.61E-04
4,4'-DDE	1.20E-02	1.48E-06
ALDRIN	1.60E-02	1.97E-06
KEPONE	7.90E-02	9.72E-06

Table 6-26
Estimated Receptor Exposure from Surface Soil
Warwick Area

Chemical Name	Selected Concentration	Plant Tissue Concentration	Insect Tissue Concentration	Deer Mouse Concentration	Deer Mouse Daily Dose	Red-Tailed Hawk Daily Dose	Raccoon Daily Dose
INORGANICS							
ANTIMONY	5.35E+00	1.61E-01	1.14E-02	9.66E-04	1.07E-03	3.16E-06	2.03E-04
BARIUM	1.83E+02	2.75E+00	1.95E-01	2.70E-03	2.70E-02	8.83E-06	6.42E-03
BERYLLIUM[a]	8.18E-01	1.23E-03	8.71E-05	8.16E-08	8.16E-05	2.67E-10	2.66E-05
CADMIUM	2.22E+00	3.33E-01	1.58E-03	8.16E-05	1.36E-03	2.67E-07	1.33E-04
CHROMIUM	1.01E+02	4.55E-01	3.59E-04	1.11E-04	1.11E-02	3.64E-07	3.35E-03
COBALT	5.01E+00	3.51E-02	2.49E-03	5.38E-04	5.97E-04	1.76E-06	1.68E-04
COPPER	2.25E+02	5.63E+01	2.22E+00	1.09E-01	2.18E-01	3.56E-04	1.77E-02
LEAD	1.18E+02	1.06E+00	8.36E-03	2.45E-02	2.45E-01	8.01E-05	4.00E-03
MERCURY	3.11E-01	6.22E-02	2.45E-03	3.70E-05	2.47E-04	1.21E-07	2.15E-05
NICKEL[a]	2.63E+01	1.58E+00	1.12E-01	4.02E-04	8.05E-03	1.32E-06	1.14E-03
TIN	9.75E+00	5.85E-02	4.15E-03	1.68E-02	1.87E-02	5.50E-05	3.28E-04
VANADIUM	1.22E+01	3.67E-02	2.61E-03	1.92E-02	2.13E-02	6.27E-05	4.04E-04
ZINC	3.91E+03	3.52E+03	1.39E+02	6.34E+00	1.27E+01	2.07E-02	7.76E-01
CYANIDE	2.70E+00	0.00E+00	0.00E+00	0.00E+00	2.55E-04	0.00E+00	8.73E-05
ORGANICS							
1,1-BIPHENYL	1.90E+00	3.83E-01	2.72E-02	1.38E-03	1.53E-03	4.51E-06	1.33E-04
1,4-DICHLOROBENZENE	3.90E-02	1.66E-02	1.18E-03	5.60E-05	6.22E-05	1.83E-07	4.34E-06
2-BUTANONE	1.22E-01	4.67E-01	3.32E-02	1.49E-03	1.66E-03	4.89E-06	9.08E-05
2-METHYLNAPHTHALENE	3.60E-01	8.19E-02	6.46E-03	2.92E-04	5.37E-03	9.53E-07	2.69E-05
2-NITROANILINE	7.00E+00	2.50E+01	1.78E+00	8.01E-02	8.91E-02	2.62E-04	4.88E-03
2,4,5-TP (SILVEX)	5.27E-02	1.09E-02	7.76E-04	3.92E-05	4.36E-05	1.28E-07	3.73E-06
3&4-METHYLPHENOL	2.20E-02	6.27E-02	4.45E-03	2.01E-04	2.24E-04	6.58E-07	1.24E-05
4-CHLOROANILINE	2.01E+00	6.81E+00	4.84E-01	2.18E-02	2.42E-02	7.13E-05	1.33E-03
4,4'-DDD	1.34E-01	1.99E-03	1.42E-04	1.77E-05	1.97E-05	5.80E-08	4.70E-06
4,4'-DDE	1.49E-01	2.96E-03	2.10E-04	2.21E-05	2.45E-05	7.21E-08	5.35E-06
4,4'-DDT	2.52E-01	3.42E-03	2.43E-04	3.23E-05	3.59E-05	1.06E-07	8.79E-06
ALDRIN	2.08E-01	1.47E-01	1.04E-02	4.84E-04	5.38E-04	1.58E-06	3.40E-05
ALPHA-BHC	1.83E-01	3.94E-02	2.79E-03	1.41E-04	1.56E-04	4.60E-07	1.32E-05
ALPHA-CHLORDANE	7.70E-02	5.15E-03	3.65E-04	2.29E-05	2.55E-05	7.49E-08	3.44E-06

Table 6-26
Estimated Receptor Exposure from Surface Soil
Warwick Area

Chemical Name	Selected Concentration	Plant Tissue Concentration	Insect Tissue Concentration	Deer Mouse Concentration	Deer Mouse Daily Dose	Red-Tailed Hawk Daily Dose	Raccoon Daily Dose
ACENAPHTHENE	1.60E-01	2.41E-02	1.90E-03	9.04E-05	1.66E-03	2.96E-07	9.65E-06
ACENAPHTHYLENE	1.10E-01	2.31E-02	1.82E-03	8.30E-05	1.53E-03	2.71E-07	7.85E-06
ANTHRACENE	3.20E-01	3.55E-02	2.80E-03	1.40E-04	2.58E-03	4.59E-07	1.69E-05
BENZO(A)ANTHRACENE	1.36E+00	3.04E-02	2.40E-03	2.12E-04	3.91E-03	6.94E-07	4.95E-05
BENZO(B)FLUORANTHENE	1.65E+00	1.02E-02	8.02E-04	1.73E-04	3.18E-03	5.64E-07	5.51E-05
BENZO(G,H,I)PERYLENE	1.20E+00	3.08E-03	2.43E-04	1.12E-04	2.06E-03	3.66E-07	3.93E-05
BENZO(K)FLUORANTHENE	1.76E+00	7.60E-03	5.99E-04	1.74E-04	3.21E-03	5.70E-07	5.84E-05
BETA-BHC	9.60E-03	2.07E-03	1.47E-04	7.40E-06	8.22E-06	2.42E-08	6.95E-07
BIS(2-CHLOROETHYL)ETHER	4.30E-01	2.26E+00	1.61E-01	7.23E-03	8.03E-03	2.36E-05	4.34E-04
BIS(2-ETHYLHEXYL)PHTHALATE	2.00E+01	4.44E-01	3.15E-02	3.12E-03	3.46E-03	1.02E-05	7.30E-04
BUTYLBENZYLPHTHALATE	7.80E-01	7.88E-02	5.59E-03	3.17E-04	3.52E-04	1.04E-06	3.98E-05
CHLOROBENZENE	6.68E-01	5.91E-01	4.20E-02	1.93E-03	2.15E-03	6.33E-06	1.31E-04
CHRYSENE	1.47E+00	3.30E-02	2.60E-03	2.30E-04	4.23E-03	7.52E-07	5.36E-05
DELTA-BHC	1.23E-01	2.03E-02	1.44E-03	7.51E-05	8.35E-05	2.46E-07	7.76E-06
DIBENZ(A,H)ANTHRACENE	1.30E-01	8.81E-04	6.95E-05	1.39E-05	2.55E-04	4.53E-08	4.36E-06
DI-N-OCTYLPHTHALATE	4.12E+00	1.54E-01	1.09E-02	8.39E-04	9.32E-04	2.74E-06	1.62E-04
DIBENZOFURAN	2.00E-01	3.22E-02	2.28E-03	1.19E-04	1.33E-04	3.90E-07	1.24E-05
DIELDRIN	1.61E-01	5.90E-02	4.19E-03	2.01E-04	2.23E-04	6.58E-07	1.62E-05
DISULFOTON	7.70E-03	1.42E-03	1.00E-04	5.15E-06	5.73E-06	1.69E-08	5.12E-07
ENDOSULFAN I	1.80E-02	6.19E-03	4.39E-04	2.12E-05	2.35E-05	6.93E-08	1.73E-06
ENDOSULFAN SULFATE	2.90E-01	6.34E-02	4.50E-03	2.26E-04	2.51E-04	7.39E-07	2.12E-05
ENDRIN	1.41E-01	3.17E-03	2.25E-04	2.21E-05	2.45E-05	7.22E-08	5.15E-06
ENDRIN ALDEHYDE	4.44E-01	9.97E-03	7.08E-04	6.95E-05	7.72E-05	2.27E-07	1.62E-05
ETHYL PARATHION	6.40E-03	1.66E-03	1.18E-04	5.83E-06	6.48E-06	1.91E-08	5.16E-07
FLUORANTHENE	1.58E+00	5.07E-02	4.00E-03	2.96E-04	5.45E-03	9.67E-07	6.04E-05
FLUORENE	2.30E-01	3.42E-02	2.70E-03	1.28E-04	2.37E-03	4.20E-07	1.38E-05
GAMMA-BHC	1.70E-03	4.72E-04	3.35E-05	1.65E-06	1.83E-06	5.38E-09	1.43E-07
GAMMA-CHLORDANE	1.49E-01	3.43E-03	2.43E-04	2.35E-05	2.62E-05	7.70E-08	5.44E-06
HEPTACHLOR EPOXIDE	1.92E-01	2.04E-01	1.45E-02	6.65E-04	7.39E-04	2.17E-06	4.41E-05
INDENO(1,2,3-CD)PYRENE	8.60E-01	1.24E-03	9.82E-05	7.71E-05	1.42E-03	2.52E-07	2.80E-05

Table 6-26
Estimated Receptor Exposure from Surface Soil
Warwick Area

Chemical Name	Selected Concentration	Plant Tissue Concentration	Insect Tissue Concentration	Deer Mouse Concentration	Deer Mouse Daily Dose	Red-Tailed Hawk Daily Dose	Raccoon Daily Dose
ISODRIN	1.55E-01	6.87E-03	4.88E-04	3.50E-05	3.89E-05	1.15E-07	6.29E-06
M&P-XYLENE	5.46E-02	2.99E-02	2.12E-03	9.97E-05	1.11E-04	3.26E-07	7.32E-06
METHOXYCHLOR	2.32E+02	2.94E+01	2.08E+00	1.13E-01	1.26E-01	3.70E-04	1.30E-02
METHYLENE CHLORIDE	2.50E-02	1.72E-01	1.22E-02	5.48E-04	6.08E-04	1.79E-06	3.27E-05
NAPHTHALENE	1.58E+00	6.99E-01	5.51E-02	2.36E-03	4.35E-02	7.72E-06	1.81E-04
NITROBENZENE	2.13E+00	6.48E+00	4.60E-01	2.08E-02	2.31E-02	6.80E-05	1.27E-03
O-XYLENE	4.60E-02	3.51E-02	2.49E-03	1.16E-04	1.28E-04	3.78E-07	8.02E-06
ORTHOPHOSPHATE	6.88E+00						
PCB-1248	1.52E+01	2.79E-03	1.98E-04	1.30E-03	1.44E-03	4.24E-06	4.90E-04
PCB-1254	5.19E+00	9.55E-04	6.78E-05	4.45E-04	4.94E-04	1.45E-06	1.68E-04
Total PCB's	1.80E+01	3.31E-03	2.35E-04	1.54E-03	1.71E-03	5.04E-06	5.82E-04
PHENANTHRENE	1.13E+00	1.16E-01	9.11E-03	4.64E-04	8.55E-03	1.52E-06	5.80E-05
PHENOL	8.90E-01	4.94E+00	3.51E-01	1.58E-02	1.75E-02	5.16E-05	9.47E-04
PYRENE	1.60E+00	6.30E-02	4.97E-03	3.37E-04	6.21E-03	1.10E-06	6.36E-05
SAFROLE	4.05E+00	5.41E+00	3.84E-01	1.75E-02	1.95E-02	5.74E-05	1.14E-03
TETRACHLOROETHENE	2.52E-01	3.36E-01	2.39E-02	1.09E-03	1.21E-03	3.57E-06	7.07E-05
TINUVIN 327	9.27E+00	1.22E-01	8.67E-03	1.18E-03	1.31E-03	3.85E-06	3.22E-04
TOLUENE	3.55E-01	3.84E-01	2.72E-02	1.25E-03	1.39E-03	4.09E-06	8.28E-05
TRICHLOROETHENE	5.97E-02	9.74E-02	6.92E-03	3.15E-04	3.50E-04	1.03E-06	2.00E-05

[a]Compound is log normally distributed. Concentration is the geometric mean.

Table 6-27
Toxicity Quotients and Cumulative Effect Totals
Production Area

Chemical Name	TQ Deer Mouse	TQ Hawk	TQ Raccoon	Cumulative Effect Totals		
				TQ Antilog Deer Mouse	TQ Antilog Hawk	TQ Antilog Raccoon
INORGANICS						
BERYLLIUM	-2.86E+00	-5.39E+00	-4.56E+00	1.39E-03	4.09E-06	2.75E-05
CADMIUM	-3.00E+00	-5.36E+00	-5.23E+00	9.97E-04	4.35E-06	5.88E-06
COBALT	-3.34E+00	-5.88E+00	-5.11E+00	4.53E-04	1.33E-06	7.74E-06
COPPER[a]	-2.31E+00	-5.10E+00	-4.62E+00	4.90E-03	8.01E-06	2.42E-05
LEAD	-1.48E+00	-4.97E+00	-3.27E+00	3.31E-02	1.08E-05	5.40E-04
MERCURY	-1.21E+00	-5.11E+00	-3.49E+00	6.12E-02	7.81E-06	3.25E-04
NICKEL[a]	-1.78E+00	-5.57E+00	-3.84E+00	1.66E-02	2.71E-06	1.44E-04
THALLIUM						
TIN	-1.90E+00	-4.43E+00	-3.65E+00	1.26E-02	3.72E-05	2.22E-04
ZINC[a]	-1.37E+00	-2.97E+00	-3.79E+00	4.31E-02	1.08E-03	1.62E-04
CYANIDE	-1.44E+00		-3.12E+00	3.65E-02		7.53E-04
ORGANICS						
2-METHYLNAPHTHALENE	-1.95E+00	-4.48E+00	-4.24E+00	1.13E-02	3.33E-05	5.78E-05
2-NITROANILINE	-2.28E+00	-4.13E+00	-4.75E+00	5.27E-03	7.36E-05	1.79E-05
3&4-METHYLPHENOL	-3.08E+00	-5.61E+00	-5.54E+00	8.39E-04	2.47E-06	2.88E-06
4-CHLOROANILINE	-9.90E-01	-3.52E+00	-3.46E+00	1.02E-01	3.01E-04	3.49E-04
ACENAPHTHENE	-2.36E+00	-4.89E+00	-4.59E+00	4.37E-03	1.29E-05	2.57E-05
ACENAPHTHYLENE	-2.30E+00	-4.83E+00	-4.58E+00	5.00E-03	1.47E-05	2.62E-05
ANTHRACENE	-4.28E+00	-6.81E+00	-6.46E+00	5.22E-05	1.53E-07	3.47E-07
BENZO(A)ANTHRACENE	-2.06E+00	-4.59E+00	-3.95E+00	8.74E-03	2.57E-05	1.11E-04
BENZO(B)FLUORANTHENE	-2.12E+00	-4.65E+00	-3.88E+00	7.63E-03	2.25E-05	1.33E-04
BENZO(G,H,I)PERYLENE	-2.21E+00	-4.74E+00	-3.92E+00	6.21E-03	1.83E-05	1.19E-04
BENZO(K)FLUORANTHENE	-2.15E+00	-4.68E+00	-3.89E+00	7.09E-03	2.09E-05	1.30E-04
BIS(2-ETHYLHEXYL)PHTHALATE	-4.85E+00	-7.38E+00	-6.74E+00	1.42E-05	4.17E-08	1.82E-07
BUTYLBENZYLPHTHALATE	-3.24E+00	-5.77E+00	-5.40E+00	5.78E-04	1.70E-06	4.00E-06
CHLOROBENZENE	-3.19E+00	-5.72E+00	-5.61E+00	6.49E-04	1.91E-06	2.45E-06
CHRYSENE	-2.03E+00	-4.56E+00	-3.93E+00	9.32E-03	2.74E-05	1.19E-04
DI-N-BUTYLPHTHALATE	-4.15E+00	-6.68E+00	-6.04E+00	7.08E-05	2.08E-07	9.03E-07
DIBENZOFURAN	-2.85E+00	-5.39E+00	-5.09E+00	1.40E-03	4.12E-06	8.06E-06

Table 6-27
Toxicity Quotients and Cumulative Effect Totals
Production Area

Chemical Name	TQ Deer Mouse	TQ Hawk	TQ Raccoon	Cumulative Effect Totals		
				TQ Antilog Deer Mouse	TQ Antilog Hawk	TQ Antilog Raccoon
DINOSEB	-3.55E+00	-6.01E+00	-5.87E+00	2.84E-04	9.70E-07	1.34E-06
ETHYLBENZENE	-2.46E+00	-4.99E+00	-4.85E+00	3.49E-03	1.03E-05	1.41E-05
FLUORANTHENE	-3.45E+00	-5.98E+00	-5.40E+00	3.55E-04	1.04E-06	3.97E-06
FLUORENE	-2.43E+00	-4.96E+00	-4.66E+00	3.70E-03	1.09E-05	2.19E-05
GAMMA-CHLORDANE	-4.07E+00	-5.82E+00	-5.97E+00	8.42E-05	1.51E-06	1.06E-06
INDENO(1,2,3-CD)PYRENE	-2.23E+00	-4.76E+00	-3.93E+00	5.91E-03	1.74E-05	1.17E-04
IRGASAN DP-300						
M&P-XYLENE	-1.67E+00	-4.21E+00	-4.06E+00	2.11E-02	6.22E-05	8.63E-05
METHOXYCHLOR	-3.00E+00	-6.53E+00	-5.20E+00	9.94E-04	2.93E-07	6.28E-06
METHYLENE CHLORIDE	-3.18E+00	-5.72E+00	-5.66E+00	6.55E-04	1.93E-06	2.18E-06
NAPHTHALENE	-2.45E+00	-4.99E+00	-4.83E+00	3.51E-03	1.03E-05	1.50E-05
NITROBENZENE	-2.37E+00	-4.90E+00	-4.84E+00	4.27E-03	1.26E-05	1.46E-05
O-XYLENE	-2.06E+00	-4.59E+00	-4.47E+00	8.74E-03	2.57E-05	3.37E-05
OCDD	-3.09E+00	-5.62E+00	-4.86E+00	8.22E-04	2.42E-06	1.37E-05
ORTHOPHOSPHATE						
PCB-1248	-2.74E+00	-4.35E+00	-4.43E+00	1.81E-03	4.49E-05	3.74E-05
PCB-1254	-2.50E+00	-5.06E+00	-4.19E+00	3.16E-03	8.62E-06	6.52E-05
PCB-1260	-3.13E+00	-5.65E+00	-4.82E+00	7.40E-04	2.25E-06	1.52E-05
Total PCB's	-1.65E+00	-4.21E+00	-3.33E+00			
PHENANTHRENE	-2.78E+00	-5.31E+00	-4.94E+00	1.66E-03	4.90E-06	1.14E-05
PYRENE	-2.95E+00	-5.48E+00	-4.94E+00	1.11E-03	3.28E-06	1.15E-05
TCDF	-3.50E+00	-6.03E+00	-5.28E+00	3.16E-04	9.30E-07	5.27E-06
TOLUENE	-3.03E+00	-5.57E+00	-5.47E+00	9.25E-04	2.72E-06	3.41E-06
TRCDF	-4.66E+00	-7.19E+00	-6.43E+00	2.21E-05	6.49E-08	3.68E-07
TRICHLOROFLUOROMETHANE	-3.12E+00	-5.65E+00	-5.57E+00	7.54E-04	2.22E-06	2.72E-06
	Ecological Toxicity Index			3.44E-01	1.90E-03	2.87E-03

[a]Compound is log normally distributed. Mean concentration is the geometric mean.

Table 6-28

Toxicity Quotients and Cumulative Effect Totals[a]
Waste Water Treatment Area

Chemical Name	TQ Deer Mouse	TQ Hawk	TQ Raccoon	Cumulative Effect Totals		
				TQ Antilog Deer Mouse	TQ Antilog Hawk	TQ Antilog Raccoon
INORGANICS						
BARIUM	-1.53E+00	-5.01E+00	-3.61E+00	2.97E-02	9.70E-06	2.47E-04
CADMIUM	-3.11E+00	-5.47E+00	-5.58E+00	7.75E-04	3.38E-06	2.61E-06
COBALT	-3.06E+00	-5.59E+00	-5.06E+00	8.65E-04	2.55E-06	8.61E-06
COPPER	-1.90E+00	-4.68E+00	-4.44E+00	1.27E-02	2.07E-05	3.64E-05
LEAD	-1.41E+00	-4.90E+00	-3.44E+00	3.87E-02	1.27E-05	3.64E-04
MERCURY	-1.49E+00	-5.40E+00	-4.00E+00	3.27E-02	3.94E-06	9.97E-05
NICKEL	-1.67E+00	-5.46E+00	-3.97E+00	2.14E-02	3.50E-06	1.06E-04
SILVER	-3.82E+00	-6.35E+00	-6.21E+00	1.52E-04	4.49E-07	6.20E-07
THALLIUM						
ZINC	-1.13E+00	-2.74E+00	-3.79E+00	7.35E-02	1.83E-03	1.60E-04
CYANIDE	-1.44E+00		-3.36E+00	3.62E-02		4.33E-04
ORGANICS						
2-METHYLNAPHTHALENE	-1.59E+00	-4.12E+00	-4.11E+00	2.57E-02	7.57E-05	7.71E-05
2-NITROANILINE	-3.13E+00	-4.98E+00	-5.82E+00	7.45E-04	1.04E-05	1.50E-06
2,3,7,8-TCDF	-2.85E+00	-5.38E+00	-4.86E+00	1.41E-03	4.15E-06	1.37E-05
2,4,5-T	-3.09E+00	-5.73E+00	-5.72E+00	8.13E-04	1.86E-06	1.93E-06
2,4-DICHLOROPHENOL	-2.38E+00	-4.91E+00	-5.00E+00	4.14E-03	1.22E-05	1.00E-05
3&4-METHYLPHENOL	-2.84E+00	-5.37E+00	-5.53E+00	1.46E-03	4.30E-06	2.96E-06
4-CHLOROANILINE	-3.25E-01	-2.86E+00	-3.02E+00	4.73E-01	1.39E-03	9.53E-04
4-CHLOROPHENYL-PHENYLETHER						
4-METHYLPHENOL	-2.76E+00	-5.29E+00	-5.45E+00	1.75E-03	5.16E-06	3.55E-06
4,4'-DDD	-4.67E+00	-6.32E+00	-6.74E+00	2.13E-05	4.80E-07	1.80E-07
4,4'-DDE	-4.08E+00	-5.11E+00	-6.19E+00	8.31E-05	7.69E-06	6.44E-07
4,4'-DDT	-4.71E+00	-7.43E+00	-6.77E+00	1.97E-05	3.73E-08	1.71E-07
ACENAPHTHENE	-1.45E+00	-3.98E+00	-3.91E+00	3.59E-02	1.06E-04	1.24E-04
ACENAPHTHYLENE	-2.67E+00	-5.20E+00	-5.18E+00	2.16E-03	6.34E-06	6.63E-06

Table 6-28

Toxicity Quotients and Cumulative Effect Totals[a]
Waste Water Treatment Area

Chemical Name	TQ Deer Mouse	TQ Hawk	TQ Raccoon	Cumulative Effect Totals		
				TQ Antilog Deer Mouse	TQ Antilog Hawk	TQ Antilog Raccoon
ACETONE	-1.62E+00	-4.15E+00	-4.33E+00	2.41E-02	7.08E-05	4.67E-05
ACETOPHENONE	-4.59E+00	-7.12E+00	-7.29E+00	2.58E-05	7.60E-08	5.17E-08
ALPHA-BHC	-4.54E+00	-6.70E+00	-7.05E+00	2.90E-05	2.02E-07	8.86E-08
ANILINE						
ANTHRACENE	-4.16E+00	-6.69E+00	-6.57E+00	6.96E-05	2.05E-07	2.71E-07
BIS(2-ETHYLHEXYL)PHTHALATE	-4.53E+00	-7.06E+00	-6.66E+00	2.93E-05	8.63E-08	2.19E-07
BUTYLBENZYLPHTHALATE	-4.33E+00	-6.86E+00	-6.73E+00	4.64E-05	1.36E-07	1.88E-07
CHLOROBENZENE	-1.98E+00	-4.51E+00	-4.63E+00	1.05E-02	3.08E-05	2.34E-05
DCDF	-3.85E+00	-6.38E+00	-5.86E+00	1.42E-04	4.18E-07	1.38E-06
DIBENZOFURAN	-1.88E+00	-4.42E+00	-4.36E+00	1.31E-02	3.84E-05	4.41E-05
DIELDRIN	-2.02E+00	-4.45E+00	-4.60E+00	9.49E-03	3.52E-05	2.49E-05
DIETHYLPHTHALATE	-2.75E+00	-5.28E+00	-5.42E+00	1.80E-03	5.29E-06	3.80E-06
ENDRIN	-2.60E+00	-5.13E+00	-4.72E+00	2.54E-03	7.47E-06	1.89E-05
ENDRIN ALDEHYDE	-1.12E+00	-5.27E+00	-3.25E+00	7.59E-02	5.37E-06	5.65E-04
ETHYL PARATHION	-1.51E+00	-4.04E+00	-4.05E+00	3.12E-02	9.19E-05	9.00E-05
ETHYLBENZENE	-3.11E+00	-5.64E+00	-5.73E+00	7.78E-04	2.29E-06	1.85E-06
FAMPHUR	-1.27E+00	-2.62E+00	-3.95E+00	5.37E-02	2.40E-03	1.12E-04
FLUORANTHENE	-3.33E+00	-5.86E+00	-5.52E+00	4.66E-04	1.37E-06	3.04E-06
FLUORENE	-1.74E+00	-4.27E+00	-4.20E+00	1.81E-02	5.32E-05	6.29E-05
GAMMA-CHLORDANE	-2.55E+00	-4.29E+00	-4.68E+00	2.84E-03	5.09E-05	2.09E-05
HEPTACHLOR	-3.12E+00	-5.12E+00	-5.34E+00	7.57E-04	7.57E-06	4.60E-06
IRGASAN DP-300						
M&P-XYLENE	-2.65E+00	-5.18E+00	-5.27E+00	2.22E-03	6.53E-06	5.35E-06
METHYL PARATHION	-8.79E-01	-3.41E+00	-3.57E+00	1.32E-01	3.89E-04	2.68E-04
METHYLENE CHLORIDE	-2.88E+00	-5.41E+00	-5.59E+00	1.31E-03	3.85E-06	2.58E-06
NAPHTHALENE	-2.13E+00	-4.66E+00	-4.73E+00	7.36E-03	2.17E-05	1.85E-05
O-XYLENE	-2.93E+00	-5.46E+00	-5.57E+00	1.18E-03	3.46E-06	2.68E-06

Table 6-28
Toxicity Quotients and Cumulative Effect Totals[a]
Waste Water Treatment Area

Chemical Name	TQ Deer Mouse	TQ Hawk	TQ Raccoon	Cumulative Effect Totals		
				TQ Antilog Deer Mouse	TQ Antilog Hawk	TQ Antilog Raccoon
OCDD	-3.98E+00	-6.51E+00	-5.99E+00	1.05E-04	3.10E-07	1.02E-06
ORTHOPHOSPHATE						
PHENANTHRENE	-2.57E+00	-5.10E+00	-4.97E+00	2.68E-03	7.89E-06	1.08E-05
PHENOL	-8.04E-01	-2.96E+00	-3.51E+00	1.57E-01	1.10E-03	3.12E-04
PHORATE	-1.20E+00	-4.23E+00	-3.85E+00	6.26E-02	5.82E-05	1.42E-04
PROPAZINE	-8.27E-01	-4.66E+00	-3.47E+00	1.49E-01	2.19E-05	3.38E-04
PYRENE	-2.73E+00	-5.26E+00	-4.95E+00	1.87E-03	5.52E-06	1.13E-05
SULFOTEPP	-2.47E+00	-5.01E+00	-5.00E+00	3.36E-03	9.88E-06	9.95E-06
TCDF	-2.94E+00	-5.47E+00	-4.95E+00	1.16E-03	3.42E-06	1.13E-05
TINUVIN 327	-3.30E+00	-5.83E+00	-5.36E+00	4.99E-04	1.47E-06	4.35E-06
TOLUENE	-2.39E+00	-4.92E+00	-5.05E+00	4.04E-03	1.19E-05	8.82E-06
TRCDF	-3.52E+00	-6.05E+00	-5.53E+00	3.03E-04	8.91E-07	2.94E-06
	Ecological Toxicity Index			1.36E+00	6.08E-03	3.80E-03

[a]Includes results from sediment sampling in seep.

Table 6-29
Toxicity Quotients and Cumulative Effects Totals for Seep Waste Water Treatment Area

SEDIMENT		
Chemical Name	TQ Heron	Cumulative Effects Antilog TQ
INORGANICS		
BARIUM		
CADMIUM	-3.56E+00	2.75E-04
COBALT		
COPPER	-2.98E+00	1.04E-03
LEAD	-2.69E+00	2.06E-03
NICKEL	-3.63E+00	2.34E-04
THALLIUM		
ZINC	-2.16E+00	6.87E-03
ORGANICS		
2-METHYLNAPHTHALENE	-2.00E+00	1.01E-02
2,3,7,8-TCDF	-1.19E+00	6.40E-02
4-CHLOROPHENYL-PHENYLETHER		
4,4'-DDD	-2.71E+00	1.96E-03
4,4'-DDE	-1.57E+00	2.71E-02
4,4'-DDT	-2.64E+00	2.30E-03
ACENAPHTHENE	-1.21E+00	6.21E-02
ACETONE	-7.06E+00	8.75E-08
ALPHA-CHLORDANE	-3.27E+00	5.42E-04
ANTHRACENE	-3.48E+00	3.32E-04
BIS(2-ETHYLHEXYL)PHTHALATE	-2.89E+00	1.29E-03
BUTYLBENZYLPHTHALATE	-3.72E+00	1.89E-04
CHLOROBENZENE	-4.86E+00	1.39E-05
DCDF	-1.15E+00	7.13E-02
DIBENZOFURAN	-1.81E+00	1.56E-02
ENDRIN	-2.33E+00	4.65E-03
FLUORANTHENE	-1.37E+00	4.30E-02
GAMMA-CHLORDANE	-2.19E+00	6.40E-03
KEPONE	-4.26E+00	5.52E-05
M&P-XYLENE	-5.88E+00	1.32E-06
NAPHTHALENE	-2.94E+00	1.16E-03
OCDD	-1.36E+00	4.38E-02
PHENANTHRENE	-1.61E+00	2.45E-02
PYRENE	-1.09E+00	8.11E-02
TCDF	-1.23E+00	5.83E-02
TINUVIN 327	-2.25E+00	5.56E-03
TOLUENE	-5.10E+00	8.03E-06
TRCDF	-8.29E-01	1.48E-01
Total		6.00E-01

Table 6-29
Toxicity Quotients and Cumulative Effects Totals for Seep Waste Water Treatment Area

SURFACE WATER		
Chemical Name	TQ Heron	Cumulative Effects Antilog TQ
INORGANICS		
BARIUM	-2.78E+00	1.65E-03
LEAD	-3.20E+00	6.28E-04
ZINC	-3.58E+00	2.60E-04
ORGANICS		
2-HEXANONE	-4.45E+00	3.54E-05
4,4'-DDE	-5.28E+00	5.27E-06
ALDRIN	-5.46E+00	3.45E-06
KEPONE	-4.71E+00	1.94E-05
Total		2.60E-03
Ecological Toxicity Index		6.02E-01

Table 6-30
Toxicity Quotients and Cumulative Effect Totals
Warwick Area

Chemical Name	TQ Deer Mouse	TQ Hawk	TQ Raccoon	Cumulative Effect Totals		
				TQ Antilog Deer Mouse	TQ Antilog Hawk	TQ Antilog Raccoon
INORGANICS						
ANTIMONY	-4.81E+00	-7.35E+00	-5.54E+00	1.53E-05	4.51E-08	2.90E-06
BARIUM	-2.27E+00	-5.75E+00	-2.89E+00	5.40E-03	1.77E-06	1.28E-03
BERYLLIUM[a]	-3.82E+00	-9.31E+00	-4.31E+00	1.51E-04	4.94E-10	4.94E-05
CADMIUM	-3.82E+00	-7.18E+00	-4.83E+00	1.53E-04	6.67E-08	1.49E-05
CHROMIUM	-2.06E+00	-6.44E+00	-2.58E+00	8.75E-03	3.64E-07	2.64E-03
COBALT	-4.40E+00	-6.93E+00	-4.95E+00	3.98E-05	1.17E-07	1.12E-05
COPPER	-2.66E+00	-5.45E+00	-3.75E+00	2.18E-03	3.56E-06	1.77E-04
LEAD	-1.31E+00	-4.80E+00	-3.10E+00	4.90E-02	1.60E-05	8.00E-04
MERCURY	-2.72E+00	-6.62E+00	-3.78E+00	1.90E-03	2.42E-07	1.66E-04
NICKEL[a]	-2.64E+00	-6.42E+00	-3.49E+00	2.30E-03	3.76E-07	3.26E-04
TIN	-1.73E+00	-4.26E+00	-3.48E+00	1.87E-02	5.50E-05	3.28E-04
VANADIUM						
ZINC	-1.56E+00	-3.16E+00	-2.77E+00	2.77E-02	6.91E-04	1.70E-03
CYANIDE	-2.52E+00		-2.99E+00			1.03E-03
ORGANICS						
1,1-BIPHENYL	-4.42E+00	-6.95E+00	-5.48E+00	3.83E-05	1.13E-07	3.32E-06
1,4-DICHLOROBENZENE	-5.68E+00	-8.21E+00	-6.83E+00	2.11E-06	6.21E-09	1.47E-07
2-BUTANONE	-4.39E+00	-6.92E+00	-5.65E+00	4.10E-05	1.21E-07	2.24E-06
2-METHYLNAPHTHALENE	-1.97E+00	-5.72E+00	-4.27E+00	1.07E-02	1.91E-06	5.38E-05
2-NITROANILINE	-2.60E+00	-4.46E+00	-3.86E+00	2.50E-03	3.49E-05	1.37E-04
2,4,5-TP (SILVEX)	-4.80E+00	-7.38E+00	-5.87E+00	1.58E-05	4.12E-08	1.35E-06
3&4-METHYLPHENOL	-5.35E+00	-7.88E+00	-6.61E+00	4.47E-06	1.32E-08	2.47E-07
4-CHLOROANILINE	-1.71E+00	-4.24E+00	-2.97E+00	1.94E-02	5.71E-05	1.06E-03
4,4'-DDD	-6.24E+00	-7.88E+00	-6.86E+00	5.80E-07	1.30E-08	1.38E-07
4,4'-DDE	-5.56E+00	-6.59E+00	-6.22E+00	2.79E-06	2.58E-07	6.09E-07
4,4'-DDT	-4.75E+00	-7.47E+00	-5.36E+00	1.80E-05	3.40E-08	4.39E-06
ALDRIN	-2.92E+00	-5.56E+00	-4.12E+00	1.19E-03	2.78E-06	7.55E-05
ALPHA-BHC	-4.05E+00	-6.21E+00	-5.13E+00	8.83E-05	6.13E-07	7.47E-06

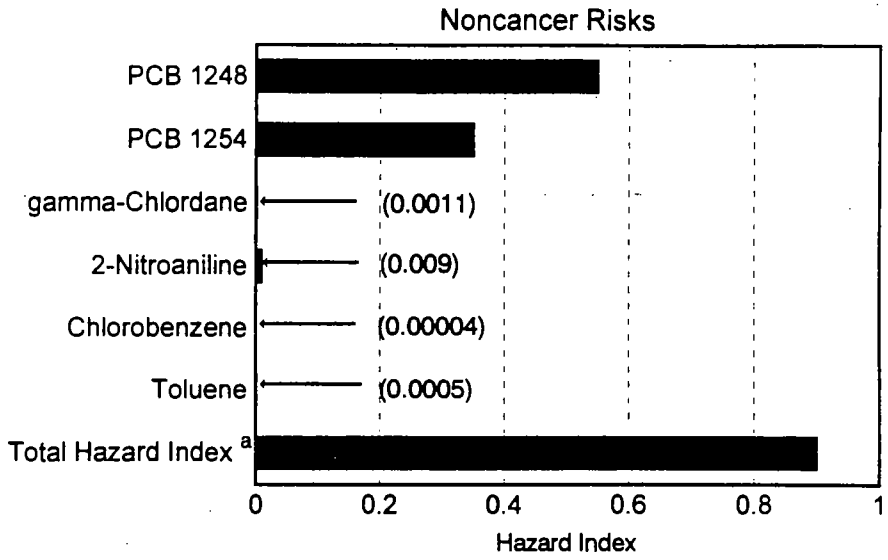
Table 6-30
Toxicity Quotients and Cumulative Effect Totals
Warwick Area

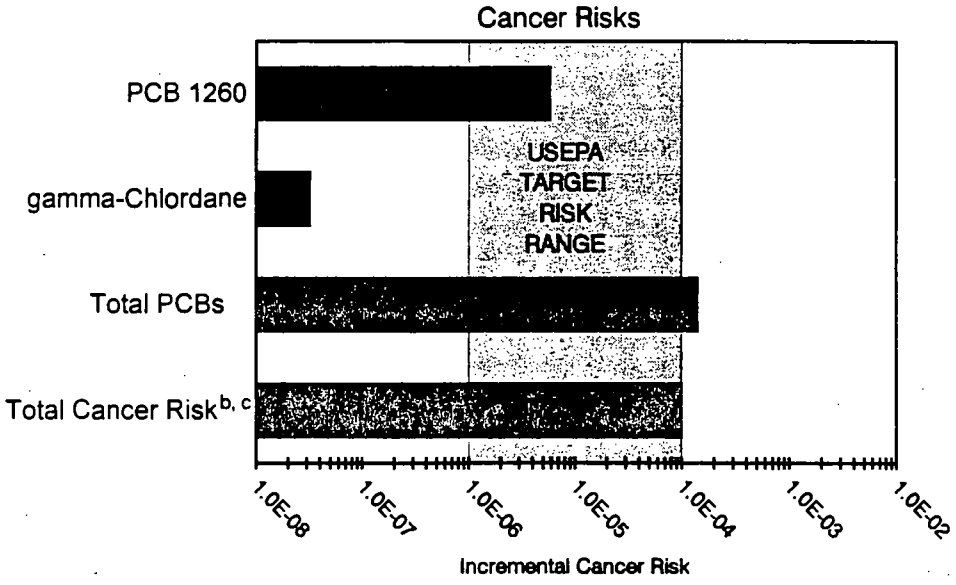
Chemical Name	TQ Deer Mouse	TQ Hawk	TQ Raccoon	Cumulative Effect Totals		
				TQ Antilog Deer Mouse	TQ Antilog Hawk	TQ Antilog Raccoon
ALPHA-CHLORDANE	-5.25E+00	-7.00E+00	-6.12E+00	5.57E-06	9.99E-08	7.54E-07
ACENAPHTHENE	-2.48E+00	-6.23E+00	-4.71E+00	3.33E-03	5.91E-07	1.93E-05
ACENAPHTHYLENE	-2.51E+00	-6.27E+00	-4.80E+00	3.06E-03	5.43E-07	1.57E-05
ANTHRACENE	-4.89E+00	-8.64E+00	-7.07E+00	1.29E-05	2.29E-09	8.47E-08
BENZO(A)ANTHRACENE	-2.11E+00	-5.86E+00	-4.00E+00	7.82E-03	1.39E-06	9.89E-05
BENZO(B)FLUORANTHENE	-2.20E+00	-5.95E+00	-3.96E+00	6.35E-03	1.13E-06	1.10E-04
BENZO(G,H,I)PERYLENE	-2.39E+00	-6.14E+00	-4.10E+00	4.12E-03	7.32E-07	7.87E-05
BENZO(K)FLUORANTHENE	-2.19E+00	-5.94E+00	-3.93E+00	6.41E-03	1.14E-06	1.17E-04
BETA-BHC	-6.10E+00	-7.49E+00	-7.18E+00	7.90E-07	3.23E-08	6.68E-08
BIS(2-CHLOROETHYL)ETHER	-2.23E+00	-4.76E+00	-3.50E+00	5.90E-03	1.74E-05	3.19E-04
BIS(2-ETHYLHEXYL)PHTHALATE	-4.94E+00	-7.47E+00	-5.61E+00	1.15E-05	3.40E-08	2.43E-06
BUTYLBENZYLPHTHALATE	-5.07E+00	-7.60E+00	-6.02E+00	8.44E-06	2.48E-08	9.56E-07
CHLOROBENZENE	-4.03E+00	-6.56E+00	-5.24E+00	9.35E-05	2.75E-07	5.71E-06
CHRYSENE	-2.07E+00	-5.82E+00	-3.97E+00	8.47E-03	1.50E-06	1.07E-04
DELTA-BHC	-5.10E+00	-6.48E+00	-6.13E+00	8.03E-06	3.28E-07	7.46E-07
DIBENZ(A,H)ANTHRACENE	-3.29E+00	-7.04E+00	-5.06E+00	5.11E-04	9.07E-08	8.73E-06
DI-N-OCTYLPHTHALATE	-4.84E+00	-7.38E+00	-5.60E+00	1.43E-05	4.21E-08	2.49E-06
DIBENZOFURAN	-3.89E+00	-6.42E+00	-4.91E+00	1.30E-04	3.82E-07	1.22E-05
DIELDRIN	-3.45E+00	-5.88E+00	-4.59E+00	3.55E-04	1.32E-06	2.56E-05
DISULFOTON	-4.34E+00	-7.47E+00	-5.39E+00	4.58E-05	3.37E-08	4.10E-06
ENDOSULFAN I	-3.87E+00	-6.86E+00	-5.00E+00	1.35E-04	1.39E-07	9.89E-06
ENDOSULFAN SULFATE	-2.84E+00	-5.83E+00	-3.92E+00	1.44E-03	1.48E-06	1.21E-04
ENDRIN	-2.75E+00	-6.90E+00	-3.43E+00	1.79E-03	1.27E-07	3.76E-04
ENDRIN ALDEHYDE	-2.25E+00	-6.40E+00	-2.93E+00	5.63E-03	3.98E-07	1.18E-03
ETHYL PARATHION	-3.89E+00	-6.42E+00	-4.99E+00	1.30E-04	3.81E-07	1.03E-05
FLUORANTHENE	-3.57E+00	-7.32E+00	-5.52E+00	2.72E-04	4.84E-08	3.02E-06
FLUORENE	-2.33E+00	-6.08E+00	-4.56E+00	4.73E-03	8.40E-07	2.76E-05
GAMMA-BHC	-5.38E+00	-8.14E+00	-6.49E+00	4.15E-06	7.17E-09	3.24E-07
GAMMA-CHLORDANE	-5.24E+00	-6.99E+00	-5.92E+00	5.72E-06	1.03E-07	1.19E-06

Table 6-30
Toxicity Quotients and Cumulative Effect Totals
Warwick Area

Chemical Name	TQ Deer Mouse	TQ Hawk	TQ Raccoon	Cumulative Effect Totals		
				TQ Antilog Deer Mouse	TQ Antilog Hawk	TQ Antilog Raccoon
HEPTACHLOR EPOXIDE	-2.96E+00	-4.96E+00	-4.19E+00	1.09E-03	1.09E-05	6.49E-05
INDENO(1,2,3-CD)PYRENE	-2.55E+00	-6.30E+00	-4.25E+00	2.84E-03	5.04E-07	5.60E-05
ISODRIN	-4.11E+00	-6.64E+00	-4.90E+00	7.79E-05	2.29E-07	1.26E-05
M&P-XYLENE	-5.59E+00	-8.12E+00	-6.77E+00	2.58E-06	7.58E-09	1.70E-07
METHOXYCHLOR	-1.60E+00	-5.13E+00	-2.59E+00	2.51E-02	7.39E-06	2.58E-03
METHYLENE CHLORIDE	-3.98E+00	-6.51E+00	-5.25E+00	1.04E-04	3.06E-07	5.59E-06
NAPHTHALENE	-2.09E+00	-5.84E+00	-4.47E+00	8.16E-03	1.45E-06	3.40E-05
NITROBENZENE	-2.41E+00	-4.94E+00	-3.67E+00	3.91E-03	1.15E-05	2.16E-04
O-XYLENE	-5.52E+00	-8.06E+00	-6.73E+00	2.99E-06	8.79E-09	1.86E-07
ORTHOPHOSPHATE		#VALUE!				
PCB-1248	-4.88E+00	-6.49E+00	-5.35E+00	1.31E-05	3.24E-07	4.46E-06
PCB-1254	-4.31E+00	-6.87E+00	-4.78E+00	4.89E-05	1.33E-07	1.66E-05
Total PCB's	-3.77E+00	-6.33E+00	-4.24E+00			
PHENANTHRENE	-2.91E+00	-6.66E+00	-5.08E+00	1.22E-03	2.17E-07	8.28E-06
PHENOL	-2.19E+00	-4.34E+00	-3.46E+00	6.49E-03	4.56E-05	3.51E-04
PYRENE	-3.11E+00	-6.86E+00	-5.10E+00	7.76E-04	1.38E-07	7.95E-06
SAFROLE	-3.08E+00	-5.61E+00	-4.32E+00	8.29E-04	2.44E-06	4.84E-05
TETRACHLOROETHENE	-4.82E+00	-7.35E+00	-6.05E+00	1.51E-05	4.46E-08	8.83E-07
TINUVIN 327	-4.73E+00	-7.26E+00	-5.34E+00	1.87E-05	5.50E-08	4.60E-06
TOLUENE	-4.56E+00	-7.09E+00	-5.78E+00	2.78E-05	8.17E-08	1.66E-06
TRICHLOROETHENE	-4.84E+00	-7.37E+00	-6.08E+00	1.46E-05	4.29E-08	8.35E-07
	Cumulative Effect Totals			2.62E-01	9.78E-04	1.59E-02

[a]Compound is log normally distributed. Concentration is the geometric mean.



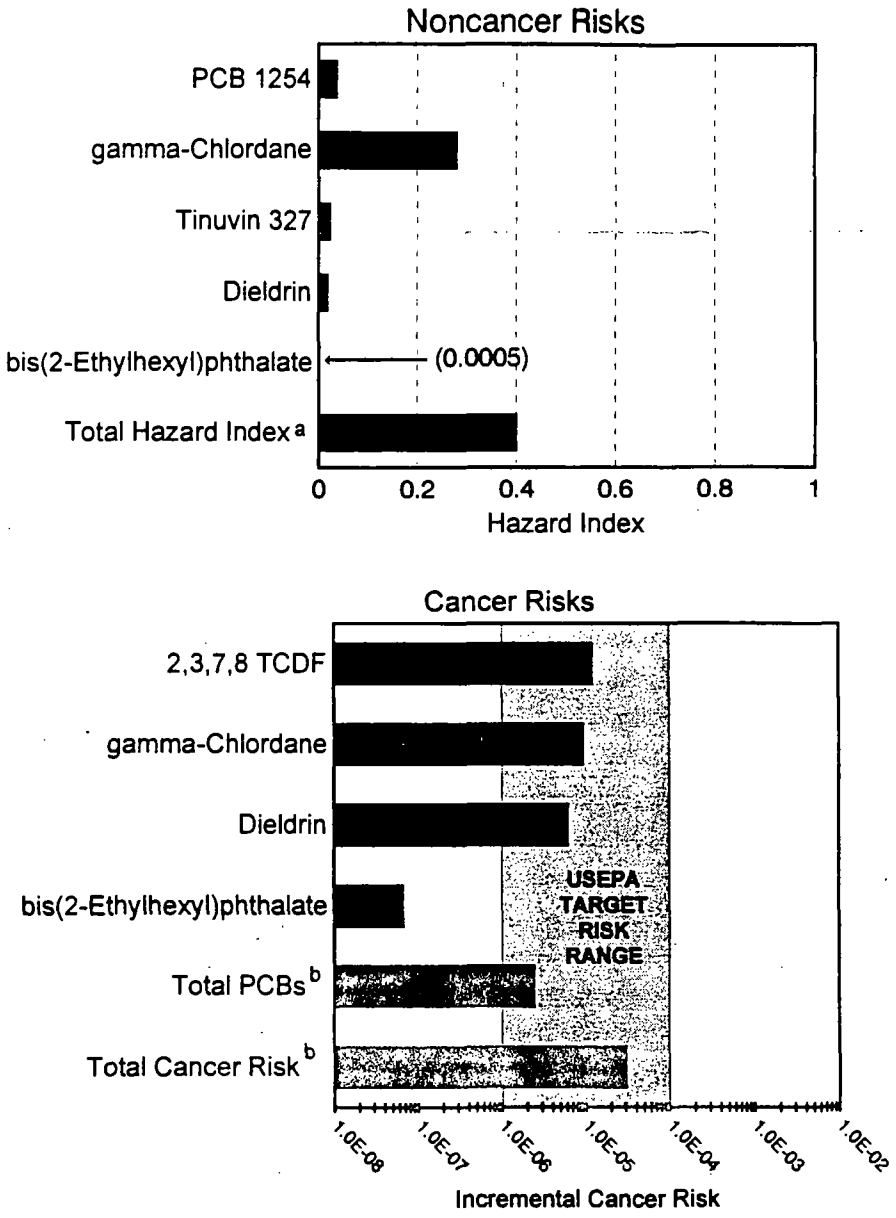


a. All hazards are summed regardless of target organ. Refer to Section 6.4.3.2 and Appendix 6-G.

b. According to USEPA policy, all PCBs were totaled, even though only PCB 1260 is carcinogenic.

c. Rounded to one significant figure, as described in the Human Health Evaluation Manual (USEPA, 1989), making total risk slightly lower than that for total PCBs.

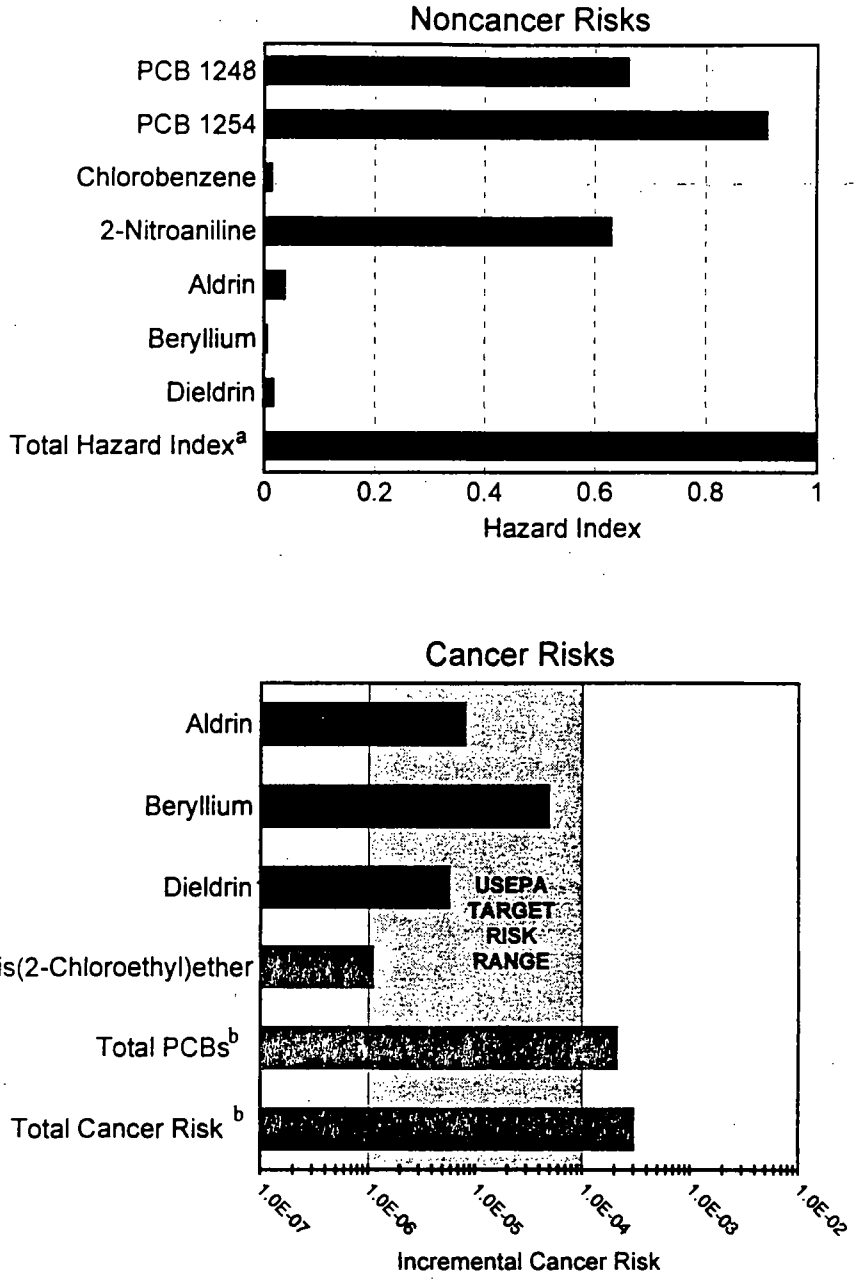
Figure 6-1. Risk Summary for Production Area On-Site Worker Scenario



a. All hazards are summed regardless of target organ. Refer to Section 6.4.3.2 and Appendix 6-G.

b. According to USEPA policy, all PCBs were totaled, even though only PCB 1260 is carcinogenic and no PCB 1260 was detected.

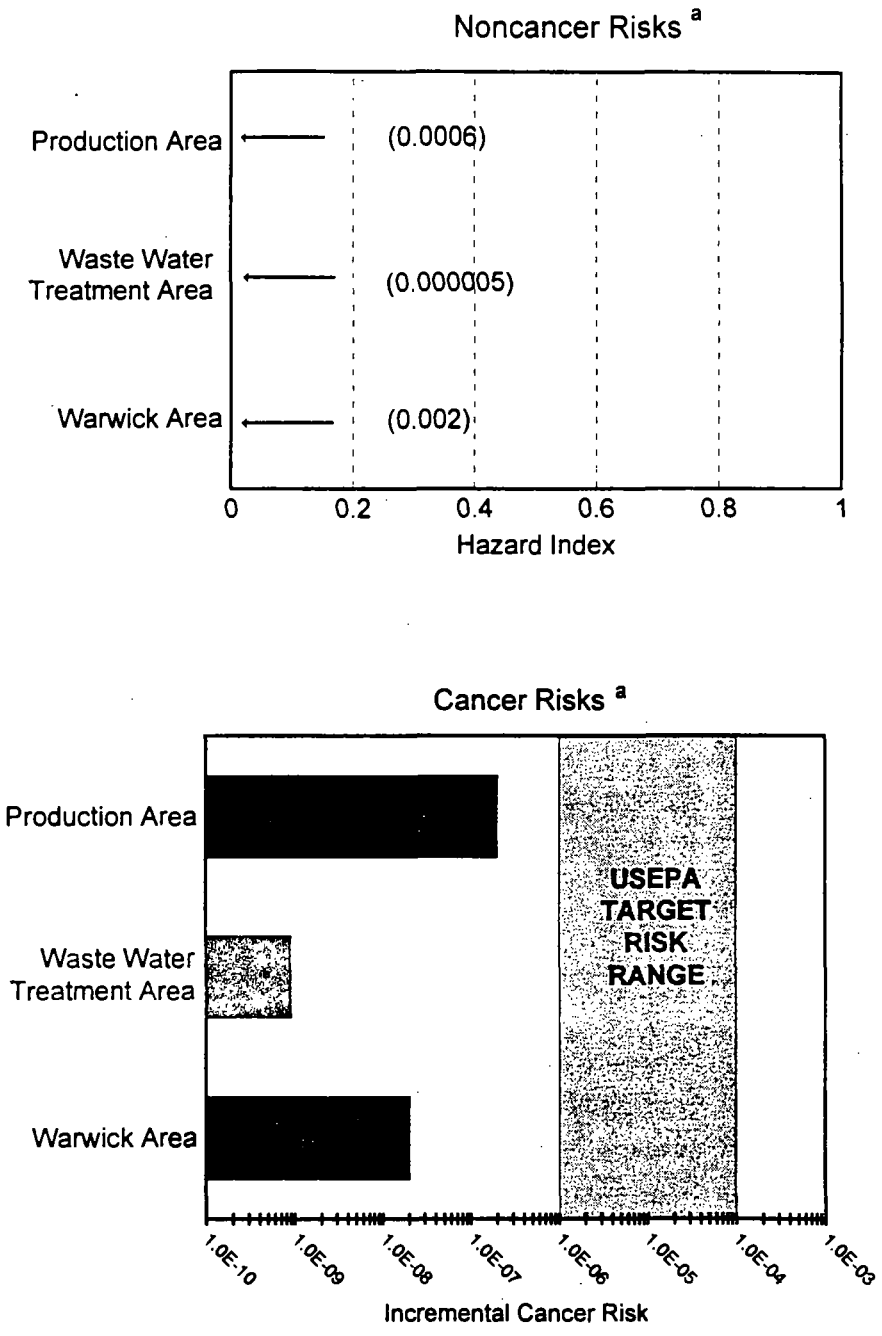
Figure 6-2. Risk Summary for Waste Water Treatment Area On-Site Resident Scenario



a. Only similar hazards are summed. Refer to Section 6.4.3.2 and Appendix 6-G.

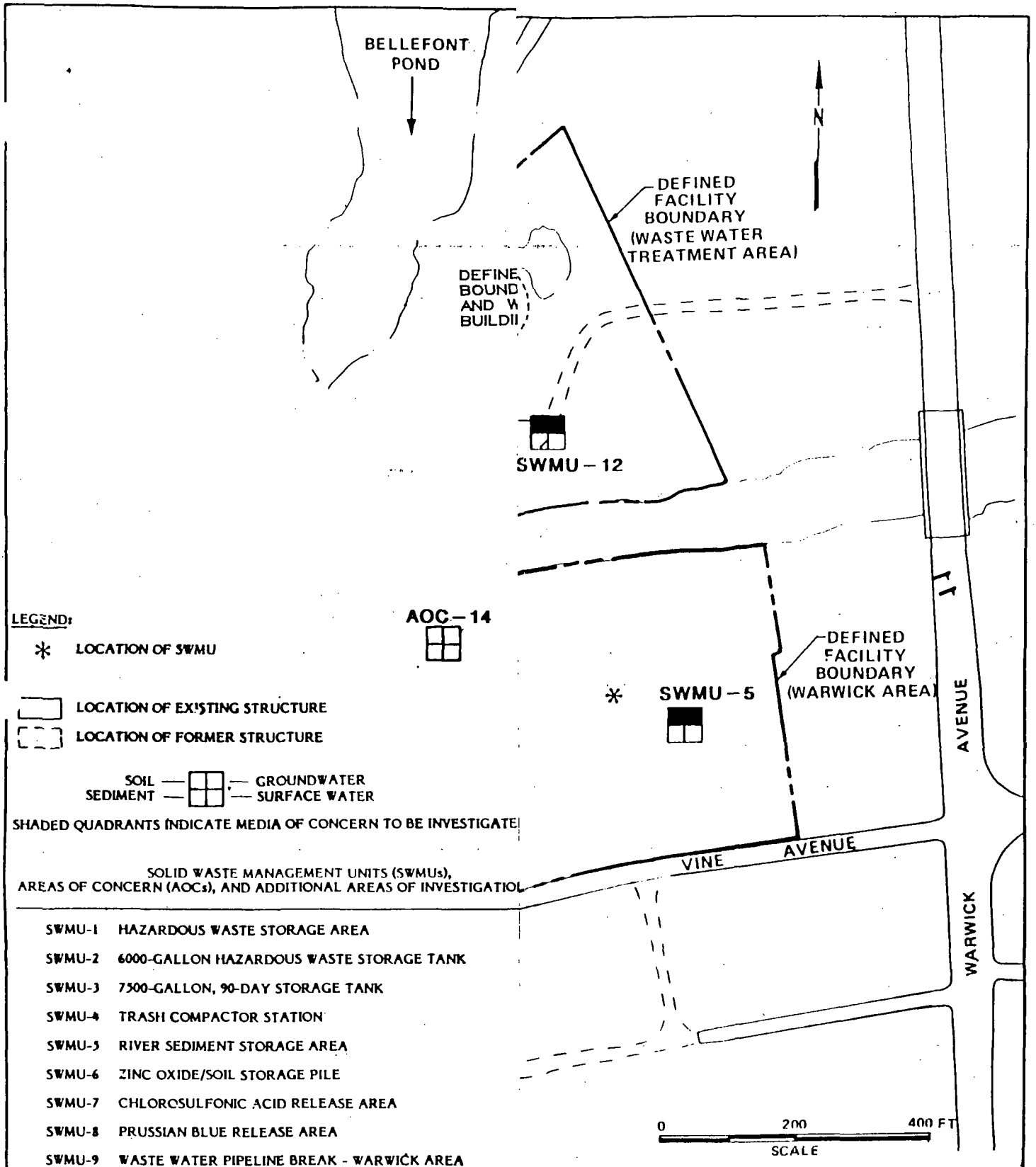
b. According to USEPA policy, all PCBs were totaled, even though only PCB 1260 is carcinogenic and no PCB 1260 was detected.

Figure 6-3. Risk Summary for Warwick Area On-Site Resident Scenario



a. Same COPCs evaluated as for other scenarios associated with Site areas. Values assume additivity for the effects of all COPCs.

Figure 6-4. Risk Summary for Canoeist Scenario



SOLID WASTE MANAGEMENT UNITS (SWMUs), AREAS OF CONCERN (AOCs), AND ADDITIONAL AREAS OF INVESTIGATIO

SWMU-1	HAZARDOUS WASTE STORAGE AREA
SWMU-2	6000-GALLON HAZARDOUS WASTE STORAGE TANK
SWMU-3	7500-GALLON, 90-DAY STORAGE TANK
SWMU-4	TRASH COMPACTOR STATION
SWMU-5	RIVER SEDIMENT STORAGE AREA
SWMU-6	ZINC OXIDE/SOIL STORAGE PILE
SWMU-7	CHLOROSULFONIC ACID RELEASE AREA
SWMU-8	PRUSSIAN BLUE RELEASE AREA
SWMU-9	WASTE WATER PIPELINE BREAK - WARWICK AREA
SWMU-10	WASTE WATER PIPELINE BREAK - WASTE WATER TREATME
SWMU-11	TOLUENE RELEASE AREA
SWMU-12	WASTE WATER TREATMENT PLANT
AOC-13	PROCESS BUILDING AREA
AOC-14	ATLANTIC TUBING AND RUBBER COMPANY PROPERTY
AAOI-15	LABORATORY BUILDING WASTE WATER SUMP
SWMU-16	MAINTENANCE DEPARTMENT CLEANING AREA

Figure 6-5
Four Site Subdivisions/Areas and Locations of SWMUs, AOCs, and AAOIs

WOODWARD – CLYDE CONSULTANTS
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
WAYNE, NEW JERSEY

DR. BY	KF	SCALE	1:2400	PROJ. NO	87X4660
CK'D BY	MH	DATE	20 JAN 1992	FIG NO.	1-1

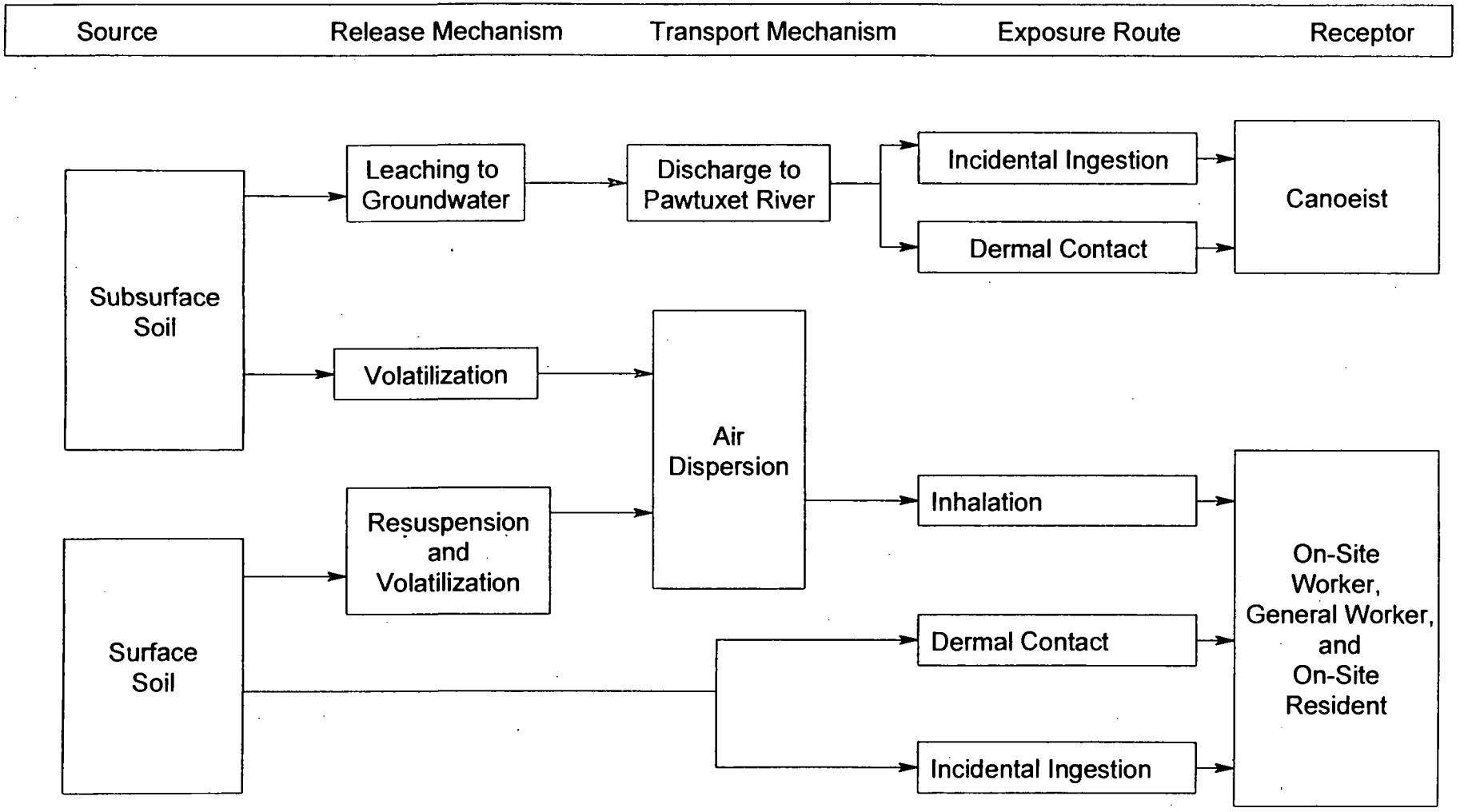
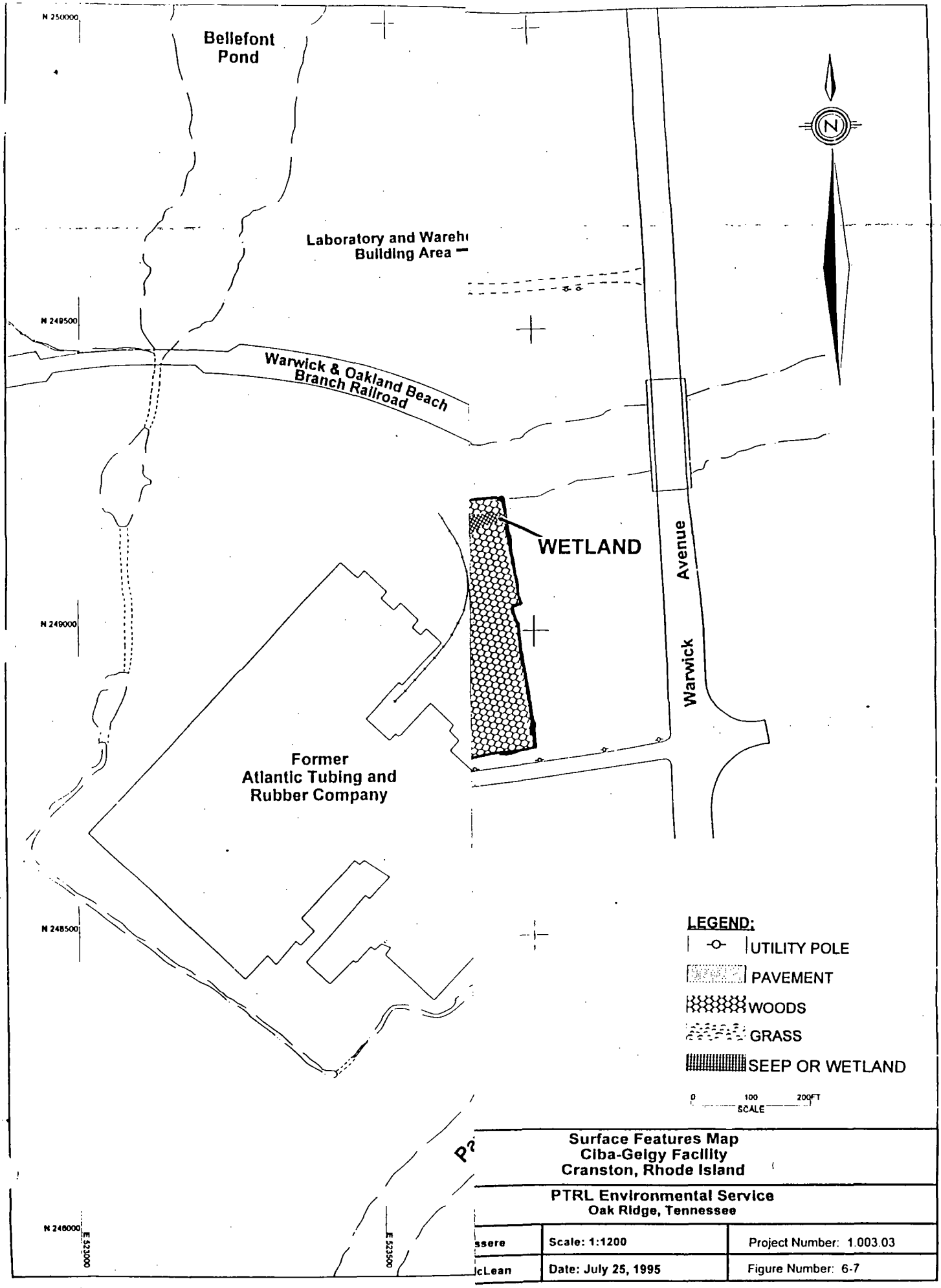


Figure 6-6
Exposure Assessment Schematic



Surface Features Map
Ciba-Geigy Facility
Cranston, Rhode Island

PTRL Environmental Service
Oak Ridge, Tennessee

ssere	Scale: 1:1200	Project Number: 1.003.03
cLean	Date: July 25, 1995	Figure Number: 6-7

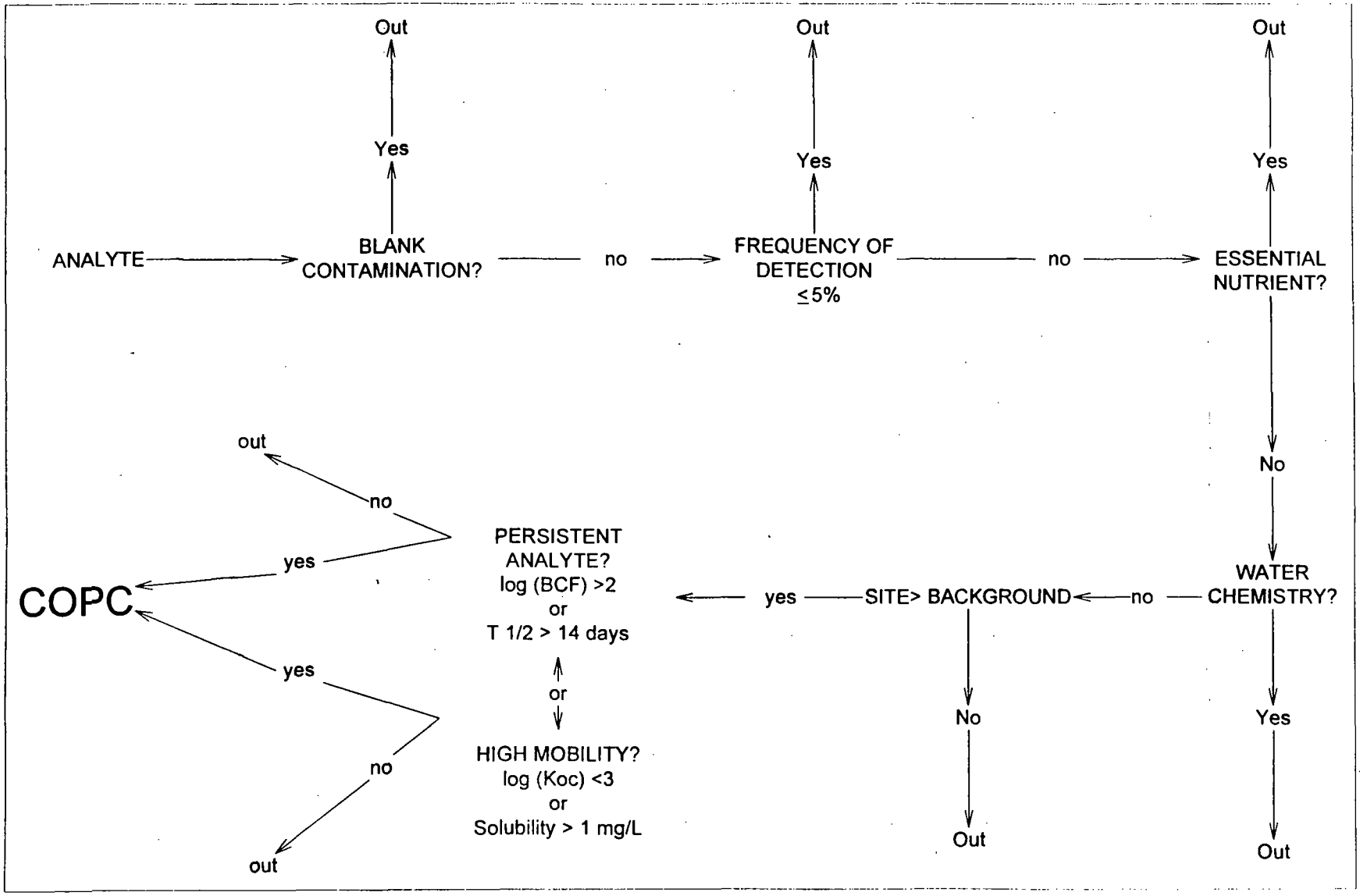


Figure 6-8. Chemicals of Potential Concern Selection Process Flowchart

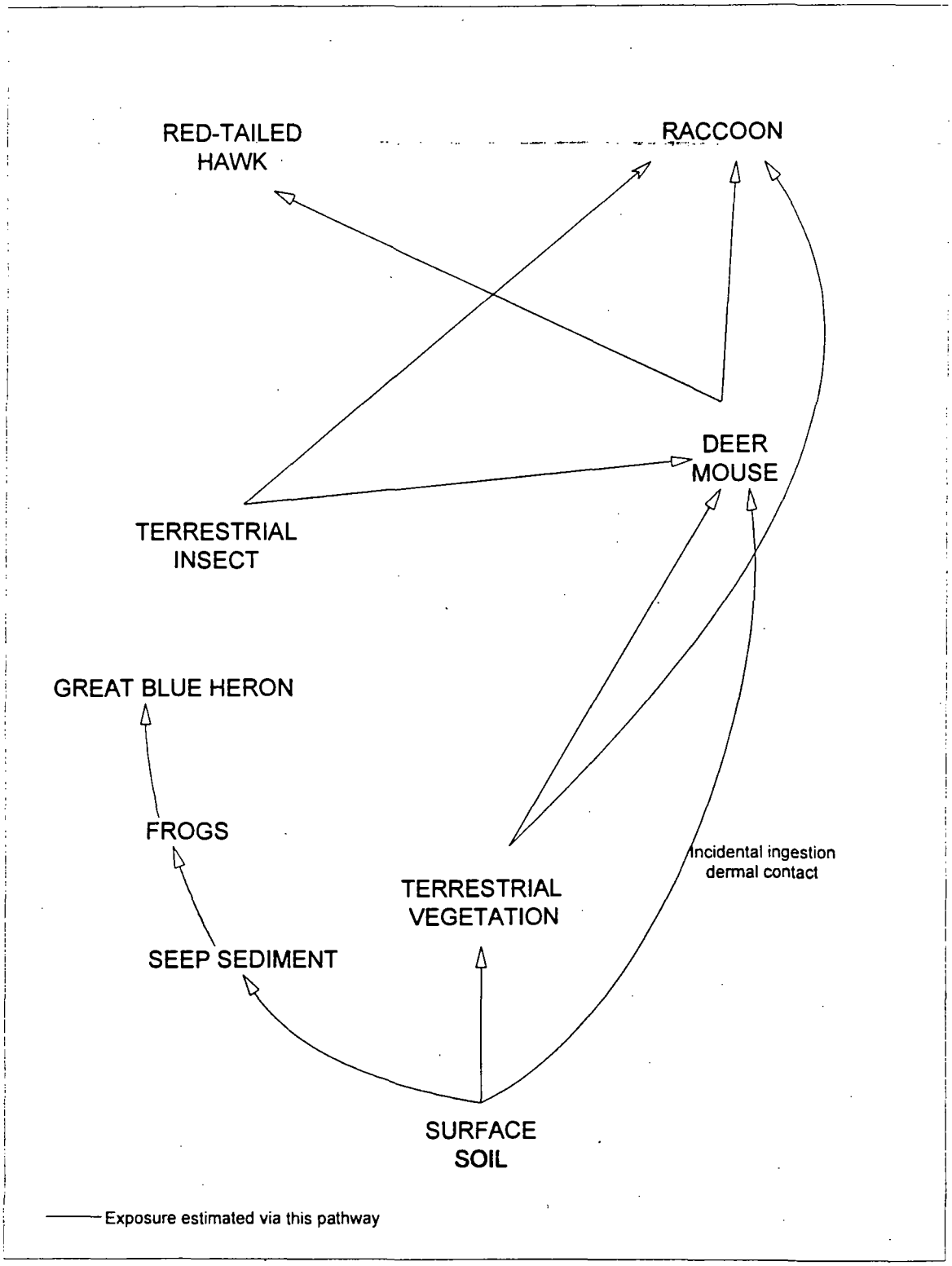


Figure 6-9. Cranston Facility Terrestrial and Semi-Terrestrial Food Web Used to Estimate Potential Dose

7.1 SUMMARY

This document presented the results of the RCRA Facility Investigation (RFI) that was conducted at the former Ciba-Geigy Corporation facility at Cranston, Rhode Island (the Site). The RFI involved three main studies - a physical characterization, a release characterization, and a public health and environmental risk evaluation (PHERE). The physical characterization was designed to evaluate the environmental setting of the Site and involved three interrelated studies - geologic, hydrogeologic and hydrologic. The release characterization was designed to evaluate the impact of releases at the Site; it was organized geographically based on the three on-site study areas (the Production Area, the Waste Water Treatment Area and the Warwick Area), off-site areas, and the Pawtuxet River. The results of the Pawtuxet River RFI will be addressed in a separate report that will be submitted at a latter date.

The PHERE was designed to evaluate if site-related chemicals will pose an unacceptable risk in the future. If the target risks for on-site chemicals were exceeded, then Media Protection Standards (MPS) for the chemicals were proposed.

The findings of this RFI are summarized in the following sections.

7.1.1 Geologic Site Model

Several methods were used to investigate the geologic characteristics of the Site including a literature review; reconnaissance mapping; geophysical surveys; subsurface investigations; and geotechnical samples analyses. Results from each of these studies were used to build the geologic model of the Site described below.

Bedrock beneath the Site consists of a medium-grained, quartz-biotite sandstone and a thin bedded, slightly phyllitic shale of the Rhode Island Formation. The depth to bedrock beneath the Site varies from approximately 30 to 90 feet below ground surface.

Bedrock is overlain by unconsolidated deposits. From ground surface to the top of bedrock these include an Upper Sand/Fill unit; a Silt unit; a Gravelly Sand unit; a Fine Sand unit; and a Glacial Till unit. The thicknesses and extents of these units vary across the Site. In the Production Area, approximately 50 to 60 feet of overburden deposits overlie bedrock. The upper unit in the Production Area is mostly fill - typically concrete rubble in a sandy matrix. The Silt unit underlies most of the Production Area, but is replaced in one area by the Gravelly Sand unit. The Gravelly Sand unit occurs only in the Production Area and is up to 25 feet thick.

The Fine Sand and Glacial Till units appear to be continuous beneath the Production Area.

Most of the Waste Water Treatment Area is also underlain by the typical stratigraphic sequence. However, the Glacial Till unit is not present at the eastern end of the area.

Most of the Warwick Area is underlain by the typical stratigraphic sequence consisting of an Upper Sand/Fill unit, Silt unit, Fine Sand unit, and Glacial Till over bedrock. The Glacial Till is found only in the western portion of the Warwick Area, and along the river.

7.1.2 Hydrogeologic Site Model

Methods used to investigate the hydrogeologic characteristics of the Site included a literature review, installing wells and piezometers, monitoring water levels, determining hydrochemisty, performing grain size analyses, and conducting aquifer permeability testing. Results from each of these studies were used to build the hydrogeologic model of the Site described below.

Groundwater that is present in the various overburden units beneath the Site is interconnected. The Silt unit acts to semi-confine the underlying Fine Sand unit. The amount of confining pressure present depends on the thickness and composition of the Silt unit. Hydraulic gradients between the shallow and deep overburden are predominantly upward, with the exception of wells near the bulkhead in the Production Area. The overburden units are hydraulically connected to the Pawtuxet River. In each area of the Site, groundwater in the shallow and deep overburden flows toward the River. Bedrock is semi-confined or confined and is not believed to be hydraulically connected to either the overburden units or the Pawtuxet River.

Groundwater discharges into the Pawtuxet River at estimated rates of 15,000 ft^3/day each in the Production and Waste Water Treatment Areas, and 45,000 ft^3/day in the Warwick Area. Groundwater flow velocities range from 6 to 28 feet/day in the Upper Sand/Fill and Gravelly Sand units and 0.6 to 38 feet/day in the Fine Sand unit.

7.1.3 Source Characterization

The Order requires that Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) and the waste placed in them be characterized. Because buildings were razed and wastes were removed when the plant was decommissioned, wastes were not available to be characterized (except SWMU-6, the zinc/oxide pile). Therefore, the source characterization is based on historical information. Potential sources identified at the Site include the following:

PRODUCTION AREA

SWMU-2 - a 6,000 gallon above ground tank used to store hazardous liquid waste containing acetone, toluene, monochlorobenzene, ethanol, isopropanol, naphthalite, xylene, heptane, and methanol. This tank had secondary containment. Wastes were pumped from the tank into railroad tank cars. No releases from this tank were known or suspected.

SWMU-3 - a 7,500 gallon above ground tank used to store waste flammable liquids. This tank had secondary containment. Wastes were pumped from the tank into railroad tank cars. No releases from this tank were known or suspected.

SWMU-4 - a trash compactor station where packaging material, waste paper, and washed fiber drums were handled. Compacted materials were taken to a sanitary landfill or incinerated. There were no known or suspected releases from this SWMU. Investigation of this SWMU is not required by the Order.

SWMU-7 - an area where approximately 500 gallons of chlorosulfonic acid were spilled from a trailer truck. Soils in the release area were neutralized and excavated. The neutralizing agent used and the amount of soil removed is not known.

SWMU-8 - it is believed (but not documented) that potassium ferrocyanide (Prussian Blue) was spilled in this area. At least 300 cubic yards of blue stained soil were removed from this area.

SWMU-11 - a subsurface sump beneath Building 11 from which waste water containing toluene was released.

AOC-13 - the portion (south end) of the Production Area where most of the manufacturing took place. Because little is known about early operations at the Site, this main manufacturing area was considered an Area of Concern.

AOC-14 - 23 acres of land west of the Production Area purchased, but not used by Ciba. Because there are no known or suspected releases from this area, investigation of AOC-14 was not required by the Order.

AAOI-15 - a waste water sump in the laboratory building at the north end of the Production Area. There are no known spills or suspected releases from this sump.

WASTE WATER TREATMENT AREA

SWMU-10 - 50,000 gallons of waste water escaped from a break in an underground pipeline in the wastewater treatment plant. The water reached the surface, flowed around an equalization tank, into a pond, and into the Pawtuxet River.

SWMU-12 - a biological waste water treatment plant which operated from 1975 to 1986 when the plant closed. While in operation, occasional sump overflow from trickling towers occurred. These waste waters would have contained volatile and semi-volatile organic compounds. Other discharges resulted in NPDES permit exceedances for zinc, BOD, and phenols. In some instances, compounds not authorized under the permit, such as chloroform, were released.

WARWICK AREA

SWMU-1 - a hazardous waste storage area used to store drums of hazardous waste. There are no known release from this area, and it was deemed to be in good physical condition at the time it was closed. Therefore, investigation of this unit was not required by the Order.

SWMU-5 - dredged river sediment storage area. This area was used to dewater 6,630 cubic yards of sediment removed from the cofferdam/waste water outfall in the river, adjacent to the Production Area. Little is known about the shape and exact location of this area.

SWMU-6 - a soil pile containing residues of zinc oxide from a broken rail car spill. This material is not a RCRA-regulated waste, and therefore, was not characterized as part of this source characterization.

SWMU-9 - 24,000 gallons of waste water was released from a pipeline break. This water is believed to have contained halogenated and non-halogenated solvents and other organic compounds.

SWMU-16 - a maintenance department cleaning area where rinse water was probably allowed to drain to a nearby surface water catch basin. This area was originally designated as an Area of Additional Investigation (AAOI) by Ciba. Phase I sampling results indicated that some contaminants were present in shallow groundwater in this area. As a result, this AAOI was reclassified as a SWMU.

7.1.4 Nature and Extent of Contamination

7.1.4.1 Groundwater

Background Groundwater - Low levels of volatile organic compounds (generally less than 50 ppb) were detected in shallow groundwater at on-site and off-site background locations. Pesticides, dioxins and furans were detected sporadically in shallow groundwater at background locations. Groundwater in bedrock at the off-site background location sampled was essentially free of contaminants.

Production Area Groundwater - Groundwater contamination is largely limited to shallow groundwater in the process building area. The primary contributors to contamination are toluene, xylenes, ethylbenzene, and chlorobenzene. Groundwater in deeper portions of the overburden contains little contamination. Groundwater in bedrock is essentially free of contaminants. Floating phase product believed to be toluene was identified in the Production Area. A non-floating phase believed to be Dowtherm was also identified.

Waste Water Treatment Area Groundwater - Low levels of groundwater contaminants were detected in shallow and deep overburden wells. The primary contributors to contamination are halogenated VOCs. Phenols were also detected in shallow wells. Samples from the bedrock well were essentially uncontaminated.

Warwick Area Groundwater - VOCs and SVOCs appear to be limited to the shallow groundwater beneath SWMU-5, and their concentrations are generally low. SVOCs are also present in the bedrock aquifer beneath SWMU-5, but the compounds detected suggest that there is no relation between compounds detected in the overburden aquifer and those in the bedrock aquifer.

Low levels (less than 35 ppb) of 1,1,1-trichloroethane were detected in shallow groundwater in the area of SWMU-16. 1,1,1-Trichloroethane concentrations decreased by an order of magnitude between January and September 1991, and was not detectable in 1993.

7.1.4.2 Soil

Background/Off-site Soil Contamination - Contaminants detected in background/off-site soil samples are typical of urban locations. All of the samples contained PAHs which are components of petroleum products such as fuels and lubricants, products of combustion, and occur naturally. Many of the samples contained toluene which is also a component of fuels. Low levels of pesticides, herbicides, chlorinated dioxins, and metals were also detected in background/off-site soil samples.

Production Area Soil Contamination - Shallow soil contamination in the Production

Area is largely limited to PCBs, xylenes, and toluene in the process building area. The highest concentrations of PCBs were found near the southern end of the process building area. The highest concentrations of VOCs in shallow soil samples were in the area of SWMU-8. Deep soil in the process building area contained ethylbenzene, xylenes and toluene. The highest concentrations of VOCs in deep soil samples were detected in the area of SWMU-11.

Toluene, chlorobenzene, ethylbenzene and xylenes were detected in soil gas samples from the process building area. The highest concentrations were detected in the area of SWMU-11. There are good correlations between high concentrations of toluene in soil samples from the area of SWMU-11 with high concentrations of toluene in soil gas results as well as between detections of high concentrations of total xylenes in soil samples from SWMUs -3, -7, -8, and -11 with high concentrations of xylenes in soil gas results. However, chlorobenzene in soil samples versus chlorobenzene in soil gas did not correlate well.

WWTA Soil Contamination - VOCs, SVOCs, and tetrachlorodibenzofuran were detected in nearly all of the soil samples. Toluene, m- & p-xylene, and chlorobenzene were detected in concentrations of 13 ppm or less. SVOCs were detected in concentrations up to 340 ppm. Tetrachlorodibenzofuran was detected in concentrations up to 8.9 ppb.

Warwick Area Soil Contamination - Contaminated soil in the Warwick Area is largely confined to soils in SWMU-5. Methoxychlor and PCBs were prevalent at relatively high concentrations in SWMU-5 shallow soil samples. One deep soil sample from SWMU-5 contained elevated levels of chlorobenzene and toluene. Bis(2-ethylhexyl)phthalate was detected in elevated concentrations in both shallow and deep soil samples.

Soil gas in the area of SWMU-16 contained 1,1,1-trichloroethane.

7.1.4.3 Surface Water

Surface water in the WWTA wetland area is essentially uncontaminated.

7.1.4.4 Sediment

The WWTA sediment contains low levels of the types of analytes seen in Site surface soils. VOCs were detected in concentrations below 0.2 ppm. PAHs were detected in concentrations below 6 ppm. Pesticides were detected in concentration below 0.6 ppm. 2,3,7,8tetrachlorodibenzofuran was detected in concentrations below 0.05 ppb. In general, the sediment does not appear to be substantially impacted by Site activities.

7.1.5 Fate and Transport of Contaminants

The assessment of the fate and transport of the chemicals of concern at the site indicate that VOCs have the highest mobility of the chemical groups identified. Therefore, these chemicals have the highest potential to migrate to the groundwater and discharge to the Pawtuxet River. Chemicals detected in the groundwater in the Waste Water Treatment Area and the Warwick Area were present in the shallow overburden and not in the deep overburden. VOCs were present in groundwater in both the shallow and deep overburden in the Production Area. VOCs present in the deep overburden in the Production Area are the result of downward vertical groundwater gradients as well as the presence of the Sand/Gravel unit which connects the shallow and deep overburden.

Most SVOCs, PCBs, pesticides, herbicides, and dioxins/furans were present predominantly in the soils due to their strongly hydrophobic nature. Therefore, these chemicals are not expected to leach appreciably from the soils. Napthalene, aniline, and benzyl alcohol, have high mobilities relative to other SVOCs and may migrate with groundwater and ultimately discharge to the Pawtuxet River.

7.1.6 Public Health and Environmental Risk Evaluation

Neither the public health nor ecological risk assessment showed that corrective actions are necessary for the three Site areas, with the possible exception of the Warwick Area. This possible exception is one of perception due to the USEPA-imposed assumption that all PCBs are treated as if they were the carcinogenic PCB 1260. No PCB 1260 was detected in the Warwick Area. The PHERE corroborates that the voluntary PCB hot-spot removals begun with the IRMs in the Production and Warwick Areas are more than sufficient to return the Site to productive uses without unacceptable risks to public health and the environment.

The public health risk assessment models for the scenarios evaluated were used to estimate risk-based MPS values for total PCBs in the hot spots targeted for remediation in the IRMs. These MPSs were developed solely for the purposes of the IRMs, and not because of any overriding potential public health or ecological health risks. Using a THI value of 1, proposed MPSs were back-calculated through the risk assessment model to the respective surface soil concentrations. The on-site worker scenario was used for the Production Area and, the on-site resident scenario (even though this may not be the most likely land use) was used for the Warwick Area. The resulting total PCB MPSs are 50 ppm for the Production Area and 5 ppm for the Warwick Area. These proposed MPSs are applicable to all PCBs and take into account the additive toxicity of PCBs 1248 and 1254.

7.1.7 Additional Tasks

7.1.7.1 Additional Areas or Media

One additional SWMU (SWMU-16), one AAOI (AAOI-15), were identified and investigated during the RFI. Additional media of concern have not been identified in the SWMUs, AOCs, and AAOIs investigated in the RFI. None of the releases identified during this investigation warranted immediate attention.

7.1.7.2 Stabilization Investigation

In early May 1992, the USEPA and Ciba agreed to pursue a stabilization investigation in the Production Area as an interim measure to stabilize or control the releases of hazardous constituents while long-term corrective action remedies are evaluated and implemented. The stabilization investigation was integrated into the RCRA Facility Investigation (RFI) through a Modification of the Order executed on 28 September 1992. The Stabilization Work Plan was submitted to the USEPA in September 1992; conditional approval of the Work Plan was granted on 21 December 1992. The Stabilization Investigation Report and Design Concepts Proposal was submitted to the USEPA in May 1993. The Draft Stabilization Design Documents were submitted to the USEPA in November 1993. The Final Stabilization Design Documents were submitted to the USEPA in June 1994 and approved on September 27, 1994. These final design documents were revised and resubmitted on January 30, 1995 because of changes to the groundwater pretreatment system.

The objectives of the stabilization design were to prevent or minimize the amount of contaminated groundwater migrating from the Production Area into the Pawtuxet River and reduce concentrations of VOCs in the soil (unsaturated zone) and groundwater (saturated zone) at SWMU-11. The stabilization design consists of capturing groundwater from recovery wells, reducing VOC concentrations with a dual phase Soil Vapor Extraction (SVE) system, and pre-treating groundwater prior to discharge to the Cranston Publically Owned Treatment Works (POTW).

7.1.7.3 Interim Remedial Measures

Interim Remedial Measures (IRMs) are being implemented at the Site. An IRM Work Plan for excavating and disposing of PCB-contaminated soil was submitted to USEPA on March 13, 1995. This Work Plan included a risk assessment which proposed IRM cleanup levels for the Production Area and for the Warwick Area (SWMU-5 and SWMU-6) .

An IRM Work Plan for dredging sediments in the former coffer dam area was prepared and submitted to RIDEM and USEPA on April 28, 1995 for review and

comment. This Work Plan addressed permitting, objectives, approach, and project management issues.

7.2 CONCLUSIONS

Based on the findings of this RFI, the following is concluded:

- Contaminated groundwater beneath the Site does not pose an unacceptable risk to human health or the environment. Potential risks posed by groundwater to human and ecological receptors in the Pawtuxet River will be addressed in a separate report.

- Contaminants in Site soils do not pose an unacceptable risk to human health or the environment.

- Contaminants in on-site surface water and associated sediment do not pose an unacceptable risk to human health or the environment.